december 1957

nlgi spokesman

journal of the national lubricating grease institute

NLGI Elects R. Cubicciotti the 25th President

Lubrication of Aircraft Oscillating Control Bearings at High Temperatures

By D. C. McGAHEY and R. S. BARNETT

Picture Highlights—NLGI 25th Annual Meeting

Data—NLGI Lubricating Grease Survey

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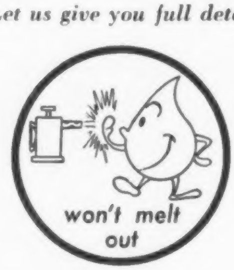

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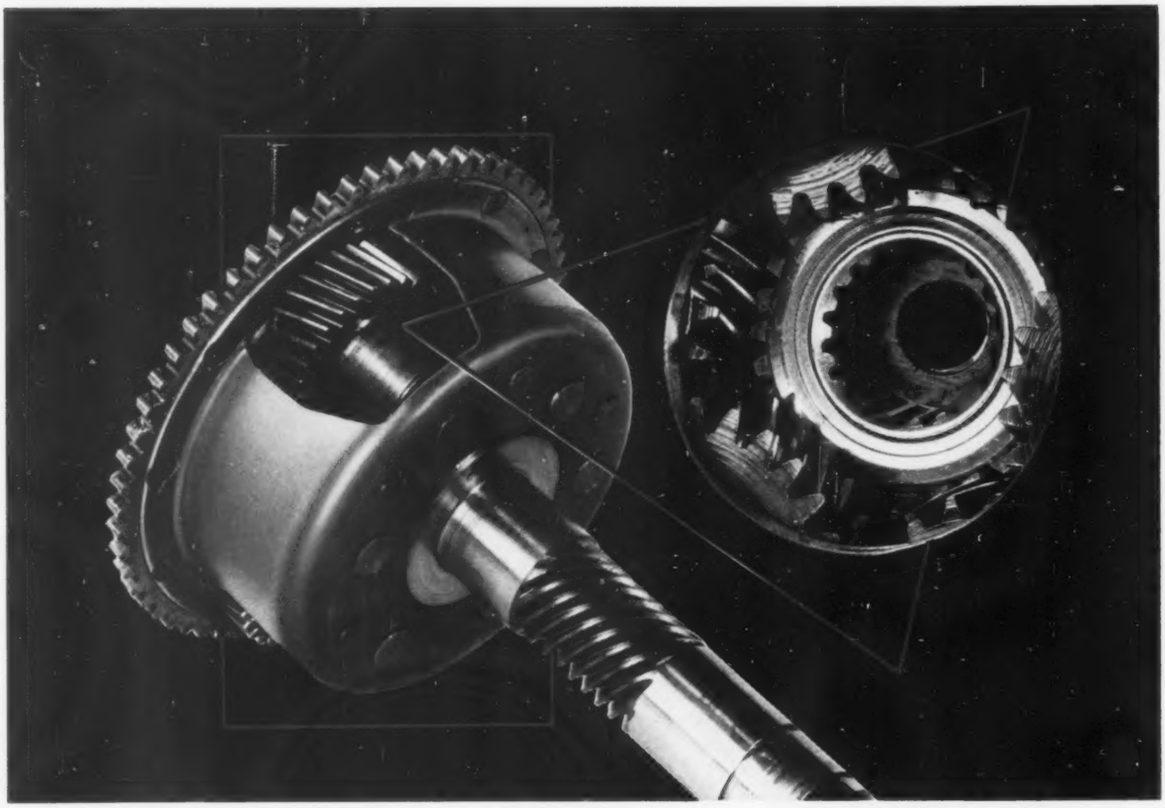

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NLGI PRESIDENT'S PAGE

By R. CUBICCIOTTI, *President*

More Than Your Interest

What are we up against in the lubricating grease industry today?

What special problems do we have to solve?

What are we doing about it?

Ours is not a static industry. We have not reached the point where we can sit back and say: "Everything is under control." It is better that we never do. It is doubtful that we ever will.

The health of the lubricating grease industry depends to a great extent on the effort that we make to keep abreast of the rapid developments, not only in our own field, but also in related areas. What happens, for instance, in the automobile industry has an important bearing on our own progress. In a similar way, other needs, whether they be for plant machinery or road building equipment or steel roll mills, are a responsibility that manufacturers of lubricating grease must meet.

That the NLGI is well aware of this situation is a tribute to the vision, the vigor and the forward look of the individual members of the Institute and its founding fathers. These characteristics are reflected in the constant activities—the research, the discussions, the programs—that are being conducted by or under the auspices or with the encouragement of the Institute to further the interests of the lubricating grease industry.

To take but one example and to see to what depth a given problem is explored, one has only to recall the symposium at our recent annual meeting on the subject of bleeding of lubricating greases. This problem was thoroughly explored at Chicago from five different aspects, including research findings and the experience of military experts, the steel industry and industry in general.

In a similar vein, the inter-relationship of the manufacturer of contractor equipment, the contracting industry itself, and the lubricating grease industry, was thoroughly sounded.

These are only a few illustrations, but they serve to indicate the scope and variety of problems that must be and are being met. The sense of pride and accomplishment that the success of our activity understandably brings us should not, however, obscure the fact that we have an overriding and never ending responsibility. And that is the development of new and improved lubricating grease products to fit definite needs as they arise, and that are economically profitable to the manufacturer.

If success were only a matter of cooperation or interest, there would be no question as to the ultimate outcome of any of our undertakings. Witness the interest in the projected lubricating grease production survey. Firms representing a vast majority of the lubricating grease output in the country have agreed to participate in this service to the industry.

But the advancement of our industry requires more than interest, more even than cooperation. It requires the active imagination of every member of the NLGI. The progress of the lubricating grease industry will be as rapid and as extensive as the sum total of the efforts of its members in proposing new and workable ideas, techniques and uses.

So let us give some serious thought on a continuous, day-to-day, week-to-week, year-to-year basis on how we can improve our products and better our industry. Don't leave all the thinking to our Technical Committee; don't depend on our liaison with other interested groups. The key to the future of the lubricating grease industry lies in the hands of the one who is most directly concerned—you. ■

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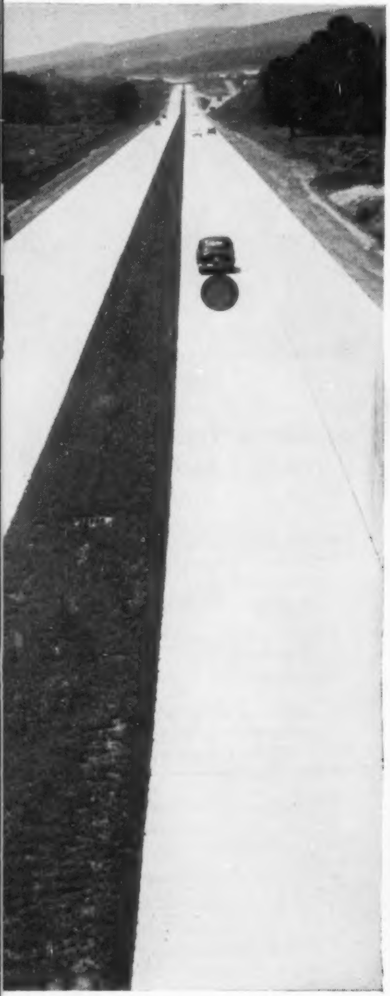

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THE COVER

IN HIS capacity of program chairman for the recent NLGI Annual Meeting, R. Cubicciotti is shown here opening the Monday morning assembly. Later events saw Cubicciotti nominated and elected as president for 1957-1958. His thinking about certain aspects of the Institute and a resume on the new president can be found on other pages of this issue (pages 5 and 13), while highlights of the program arranged by Cubicciotti are as vice president and program chairman for the preceding year shown elsewhere in the magazine (see pages 28 to 32).

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Future Meetings

DECEMBER, 1957

1-6 ASME, Annual Meeting, Statler Hotel, New York City.

3-4 Petroleum Packaging Committee, quarterly meeting, Hotel Washington, Washington.

5-6 API Oil Information Committee meeting, Biltmore Hotel, New York City.

JANUARY, 1958

13-17 Society of Automotive Engineers, Annual Meeting, Sheraton-Cadillac and Statler Hotels, Detroit.

22 Independent Oil Men's Assn., Annual Meeting, Hotel Statler, Boston.

22-23 Northwest Petroleum Assn. Annual Meeting, and trade show, Nicollet Hotel, Minneapolis.

FEBRUARY, 1958

2-7 ASTM Committee D-2 Meeting, Rice Hotel, Houston.

10-14 ASTM National Meeting, Hotel Statler, St. Louis, Mo.

12-14 API Division of Marketing, Marketing Research Committee, Biltmore Hotel, New York City.

26-28 API Division of Production, Southern District Meeting, Shamrock-Hilton Hotel, Houston.

27-28 API Division of Marketing, Lubrication Committee Meeting, Sheraton-Cadillac Hotel, Detroit.

MARCH, 1958

4-6 SAE Passenger Car, Body and Materials Meeting, Sheraton-Cadillac, Detroit, Mich.

19-20 Ohio Petroleum Marketers Association, Annual Convention and Marketing Exposition. Deshler-Hilton Hotel, Columbus, Ohio.

31-Apr. 2 SAE National Production Meeting and Forum, The Drake, Chicago, Ill.

APRIL, 1958

9-11 API Division of Production, Mid-Continent District Meeting, Biltmore Hotel, Oklahoma City.

16-18 National Petroleum Association, Cleveland, Ohio

22-24 ASLE Annual Meeting and Exhibit, Hotel Cleveland, Cleveland, Ohio.

MAY, 1958

19-20 API Division of Marketing, Lubrication Committee Meeting, Point Clear, Ala.

21-23 API Division of Marketing, Midyear Meeting, Roosevelt Hotel, New Orleans

22-23 API Division of Production, Pacific Coast District Meeting, Biltmore Hotel, Los Angeles.

JUNE, 1958

8-13 API Division of Production, Midyear Committee Conference, Hollywood Beach Hotel, Hollywood, Fla.

8-13 SAE Summer Meeting, Chalfonte-Haddon Hall, Atlantic City, N. J.

22-28 ASTM 61st Annual Meeting, Hotel Statler, Boston, Mass.

SEPTEMBER, 1958

10-12 National Petroleum Association, Atlantic City, N. J.

OCTOBER, 1958

20-22 SAE National Transportation Meeting, Lord Baltimore Hotel, Baltimore, Md.

27-29 NLGI Annual Meeting, Edgewater Beach Hotel, Chicago, Ill.

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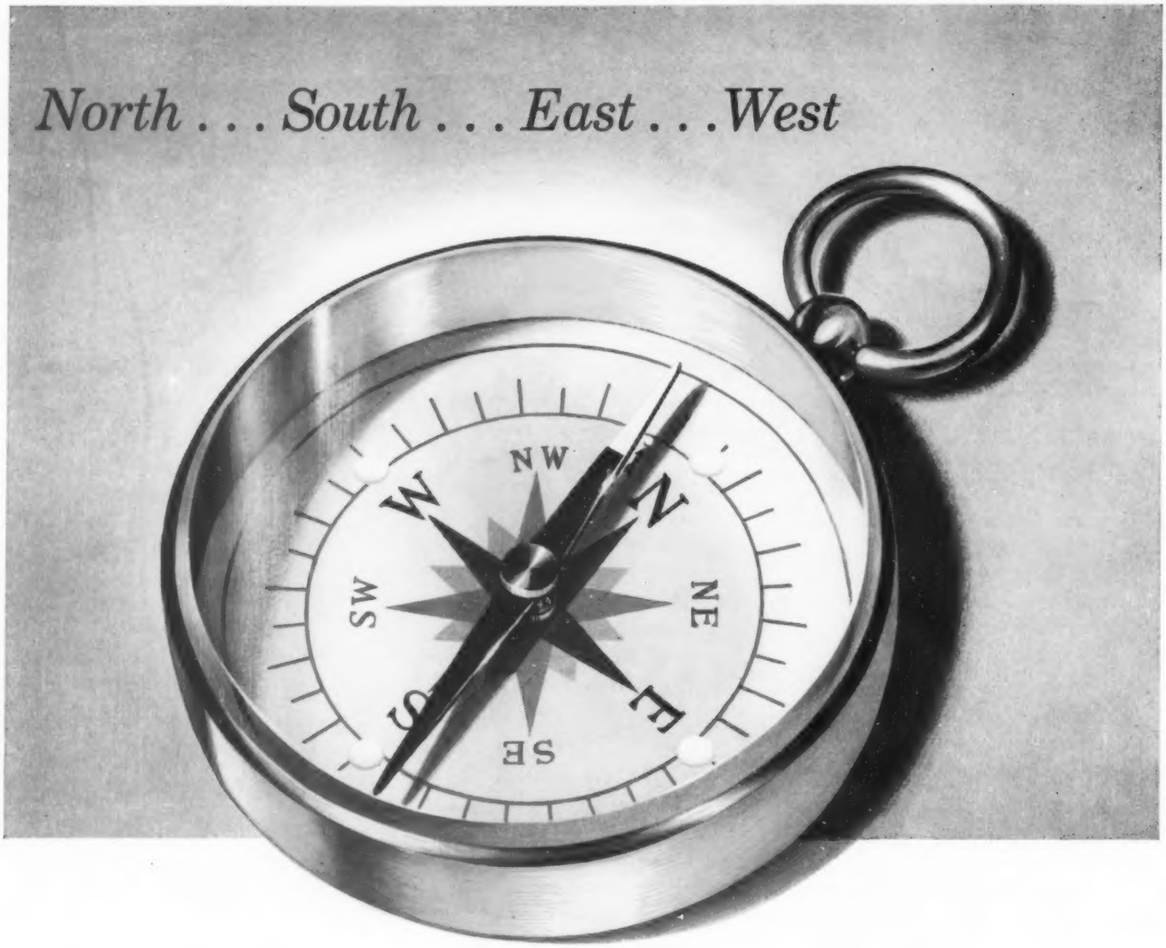

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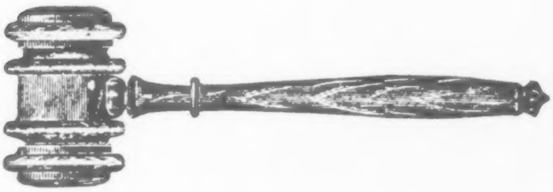
Article II, Section 1, Paragraph 5, NLGI By-Laws



NLGI Elects R. Cubicciotti the 25th President

RUDOLPH CUBICCIOTTI, newly elected president of National Lubricating Grease Institute, is the organization's twentyfifth chief executive. He was elected at the annual meeting October 28-30 in Chicago, marking the beginning of NLGI's quarter century year.

A member of the L. Sonneborn Sons, Inc. firm since 1943, Cubicciotti is currently a vice president of the company which refines and produces automotive lubricants, greases, petrochemicals, waxes and building products for industrial and consumer applications. The L. Sonneborn Sons firm was a charter member of the National Lubricating Grease Institute, with representatives attending the first meeting, June 29, 1933.

Cubicciotti was formerly with Union Oil company of California, where he was chemist, supervisor of grease manufacture for seven years and then became technical assistant and later manager, lubricants and special products department.

He has served on a number of NLGI committees, has been a director since 1949 and most recently was vice president in 1956-1957. A past chairman of the Lubrication Committee of the American Petroleum Institute's Marketing Division in 1954, he is also a member of the Society of Automotive Engineers.

Scarsdale, New York is the family residence of the Cubicciottis, where he pursues a boating hobby in power cruiser predicted log racing, placing eighth in national standing in 1956. He is a member and past commodore of the Orienta Yacht club, a member and past commander of the Westchester Power squadron.

Lubrication of Aircraft Oscillating Control Bearings at HIGH Temperatures

By D. C. McGahey and R. S. Barnett Texaco Research Center of the Texas Company

Abstract

Lubrication of control bearings at temperatures ranging up to 550° F. has become a serious problem in high speed, high altitude aircraft. For instance such bearings, operating in or near the hot gaseous discharge of the engine exhaust, may tend to lock on occasions due to deterioration of the grease, seals, and/or "growth" of bearings. Hence, the problem needs rectification at the earliest possible date.

In order to investigate this problem in the laboratory, a test rig was developed and constructed by Texaco Research Center to simulate control bearing action at elevated temperatures. This apparatus was designed to achieve conditions of load, degree of oscillation, and frequencies of motion representative of control bearings in military aircraft operation.

After some exploratory work, a test procedure was finalized and tests conducted on a number of lubricants and bearing seals for the purpose of evaluating them for use in control bearings at elevated temperatures.

The above subject has been studied by a sub-panel of the High Temperature Grease Panel of the CLR Airframe Lubricants Group.

On the basis of the work carried out in this investigation of aircraft control bearing lubrication at elevated temperatures, the following conclusions are drawn:

1. A tester simulating control bearing operation at elevated temperatures has been operated successfully over a temperature range of from 350 to 550° F.

2. Erratic results obtained, particulary at 400° F., may be attributed to melting or excessive softening of some lubricants at the test temperature and consequent seepage past seals, leaving variable amounts of residues in the bearings.

3. Seals of special heat-resistant materials are required for use at the temperatures investigated.

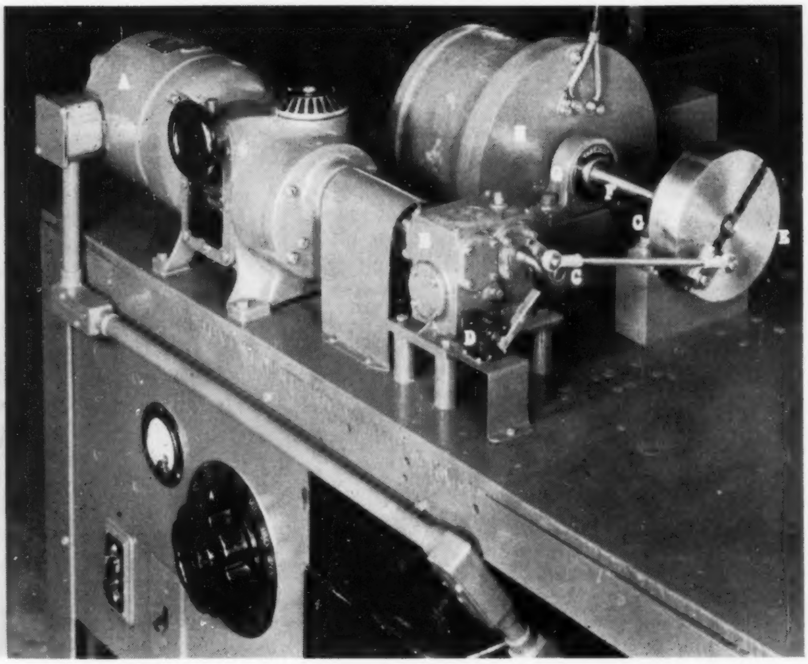


FIGURE I. An overall view of the high temperature oscillating control bearing tester. The speed-ranger (A) rotates at 500 RPM, imparting rotary motion through a 50 to 1 gear reducer (B) to turn (C).

Presented at the American Society of Lubrication Engineers' Annual Meeting, April 6, 1956, Pittsburgh, Pa.

4. *Certain of the lubricants and seals tested have shown promise at temperatures up to 550° F.*

History

IT WAS DEVELOPED through a visit to the engineering laboratories of the Air Material Command (now Wright Air Development Center) in 1949 that one of the serious problems being encountered by the Air Force was the lubrication of control bearings at temperatures approaching 500° F. These particular bearings are presumably used on guided missiles, rocket, and jet engine planes where such bearings are located close to the tail cone assembly.

In discussing this matter further with the bearings unit, aircraft laboratory of Wright Field, it was found that the Air Force had decided to construct a test rig as an interim measure to screen *existing* aircraft control bearings and lubricants for high temperature operation, with the anticipation that *bearings* and *lubricants* might be developed capable of satisfactory operation over an extended period at 500° F. The requisites set forth for this test rig were that it should be capable of testing a KP-16A elastomer-type seal bearing under the following conditions:

1. Radial Load .... 200 Pounds
2. Temperature .... 250 to 600° F.
3. Total Oscillation .... 90°[1]
4. Speed ... 600 Oscillation Cycles per Hour

These conditions of load, speed and amplitude of oscillation were regarded as representative of operation of a jet fighter at that time.

The actual problem was locking of the control bearings by deterioration of the grease and possible softening and/or "growth" of the bearings at high tem-

1. 45 degrees in each direction.

peratures. As an example of control bearing operating temperatures encountered in production aircraft, one of the control bearings of an F-93 fighter was cited as operating at 350° F. Higher temperatures are being encountered in experimental equipment, with even higher temperatures anticipated for the future.

The initial phase of the program was largely exploratory in nature to develop a suitable test procedure. During this development period, attention was directed to a report issued by North American Aviation, Inc.[2] entitled "Lubrication of Pulleys at High Temperature with AN-G-25 Grease." It was pointed out in this report that a continuous operating temperature of 290° F. and an intermittent temperature of 350° F. could be expected in a particular primary control-surface pulley operating in a YF-93A jet engine fighter. In developing a test to simulate required pulley life, the required service life expectancy of the pulley under test[3] was indicated by North American Aviation to be 70,000 cycles at 80 cycles per minute and 180° bearing rotation. The primary conclusion of the North American report was that the AN-G-25 grease satisfactorily lubricated the M-4A pulley- bearing combination undergoing this simulated service test. Another point of interest brought out was that the torque required to rotate the test pulleys increased from an initial average reading of 7 inch-pounds to 11 inch-pounds. Maximum torque developed was 12 inch-pounds.

Since the results of the tests were of general interest to the airframe industry, the preliminary data were presented to the Coordinating Research Council, CLR airframe lubricants group, laboratory panel on high temperature grease testing. A small sub-panel on oscillating control bearing testers was formed for developing a tentative research technique to evaluate lubricants in this regard. However, owing to the press of more urgent commitments, the other participants have not been able to devote the necessary manpower for the construction of a suitable tester, or to the utilization of existing testers to carrying out the proposed program. Therefore, the ensuing cooperative work consisted of testing at Texaco Research Center, Beacon, New York, several greases in bearings with special seals provided by two bearing manufacturers.

2. Report NA-50-478, Engineering Research Laboratory of North American Aviation, Inc., issued April 27, 1950.

3. Atco M-4A aluminum alloy pulley utilizing a Fafnir K-4 ball bearing.

4. Test results indicated that the plya-seals used in the KP-16A bearing deteriorated at high temperatures. Therefore, some of the later tests were made with KP-16A bearings with teflon and teflon-fiberglas seals furnished by the Fafnir Bearing company and with Marlin Rockwell Corporation prepacked K-16-ALL-11 metal sealed bearings.

Apparatus

1. *Original Design*

The high temperature oscillating control bearing tester is essentially a device for imparting oscillatory motion to a test bearing maintained at elevated temperatures. An over-all view of the mechanism is shown in Figure 1, and consists of a speedranger (A) rotating at 500 RPM which imparts rotary motion through a 50 to 1 gear reducer (B) to turn crank arm (C) at 10 RPM. The crank in turn actuates counter (D) which records the number of bearing oscillation cycles completed and imparts oscillatory motion to flywheel (E) at a speed of 10 cycles per minute. Shaft (F) which is supported by pillow blocks (G, only one pillow block shown in Figure 1) transmits the oscillatory motion to a KP-16A test bearing, the test bearing being mounted on the end of the shaft inside of oven (H). Additional details on the construction of the tester are shown in the appendix.

2. *Modified Design*

The original design gave trouble from the standpoint of grease leakage in some cases to the No. 212KS bearing which acted as the trunnion support for the KP-16A test bearing. Fortuitous accumulation of leakage interfered to a greater or lesser extent with the torque-transmitting functioning of the trunnion bearing, promoting erratic end results; i. e., the torque of the test bearing might not be transmitted to the cut-off switches in those cases where the trunnion bearing was "gummed up" with deposits. Consequently, the unit was redesigned to incorporate dead-weight-loaded micro-switches to improve reproducibility. Provisions were also made for more rapid assembly and disassembly and better temperature control. Details of the modified tester are found in the appendix. No test results from the modified tester are available for inclusion in this paper.

Procedure

1. *Bearing Preparation*

A standard Fafnir KP-16A (AN-B-4 Spec. part No. AN-201 series) aircraft control bearing was used[4]. This is a full type cageless bearing having 1.000 inch bore and 2.000 inch O.D., with nineteen ¼-inch balls, and two elastomer "plya-seals" held in place with split retaining rings of thin stainless steel. The sealing washers ride in a circular sectioned groove on the edge of the inner ring.

Before testing, each bearing was thoroughly cleaned by removing the split retaining rings and plya-seals, washing in Stoddard solvent and air drying. The bearing was lubricated by hand; the interstices being completely filled with the grease to be tested. Excess lubricant was then removed so that two grams remain

in the KP-16A bearing. The plya-seals and steel retaining rings were reinserted in the bearing and the bearing placed in the test bearing housing. The test bearing and housing were then pressed into the inner ring of the torque bearing and the entire assembly (torque bearing, test bearing and housing) mounted and locked on the shaft.

2. *Calibration of Cut-Off Micro-Switches*

Two methods of calibrating the cut-off micro-switches were used and are described below. The calibration method used for any particular test is indicated with the test result.

a. *Original Procedure*

A 200-pound radial load was applied to the bearing by means of the loading rod and dead-weight arrangement which fastened to the self-aligning outer ring of the torque bearing. The torque cut-off rod was then attached to the inner ring of the torque bearing with the opposite end of the rod butted against the spring-loaded micro-switches. With a torque of one foot-pound applied to the inner ring of the torque bearing (by means of a lever and weight arrangement), the spring-loaded micro-switches were set to cut out at this point. This initial torque was then removed, thereby leaving the micro-switches preset to shut down the equipment when a torque in excess of one foot-pound was developed in the test bearing during actual test.

b. *Revised Procedure*

When work was begun with bearings using seals other than plya-seals, it was recognized that variations in friction torque of new bearings, resulting from differences in seal pressure and variations in grease consistency, produced variations in the effective setting of the cut-off micro-switches. To eliminate this variable, the procedure was revised so that an oiled KP-16A bearing without seals was installed in the apparatus while the cut-off micro-switches were being calibrated.

At first the torque limit of one foot-pound was retained with the revised procedure. Later this was reduced to 0.9 foot-pounds in an effort to reduce test duration with high-quality lubricants.

3. *Test Operation*

With the oven fastened in place around the test bearing assembly, the heater variac was set for the test bearing temperature desired[5].

The equipment was started by means of the electrical operating circut through a time clock. The purpose of the time clock was to automatically cycle the test as follows:

a. At the beginning of operation, the motor and heater circuit were turned on and held at the conditions of test for four hours.

b. At the end of four hours of operation, the time clock automatically opened the motor and heater cirsuits allowing the equipment to rest and cool for four hours.

c. The cyclic procedure above was subsequently repeated until either a failure occurred (that is, until the bearing torque exceeded the preset limit and automatically shut down the entire test unit) or until 72,000 oscillation cycles of satisfactory operation were obtained. In the later work, tests were extended beyond 72,000 oscillation cycles for better discrimination between seals and lubricants.

The actual conditions of test are outlined below:

a. Bearing – KP-16A (AN-B-4 Spec. Part No. AN-201 Series).

b. Load, Lb.–200 Radial.

c. Speed–600 Oscillation Cycles/Hour[6].

d. Oscillation–90° Total (Inner ring oscillation).

e. Temperature, °F.–350; 400; 450; 500; 550.

f. Failure Criteria–1 ft.-lb. torque developed in bearing[7].

g. Length of Test–72,000 Oscillation Cycles (120 hours) or longer.

h. Type of Test–Cyclic; 4 hours of running at test temperature; 4 hours at rest and cooling.

Test Results

A list of the lubricants evaluated is shown in Table I, facing. Included in the tabulation is general information on the lubricant and the military specifica-

5. Figure 5, page 22 of the appendix, shows provision made for a celectray to be used in conjunction with the heater variac for better test bearing temperature control. This refinement was not used in the work reported herein.

6. A second unit was constructed out of spare parts to facilitate testing. In those instances where the first version of the second unit was used, the speed was 720 oscillation cycles per hour. Machine No. 2 was later modified so that subsequent tests on this unit were run at the speed specified which was 600 oscillation cycles per hour. The data indicate which speed was used in each test. There are not sufficient data to indicate whether differences in oscillation frequency of this magnitude had an appreciable effect on test results. In view of other variables discussed later in this paper, it is thought that the differences in oscillation frequency were probably negligible.

7. 0.9 foot-pound in some cases as noted under "Revised Procedure," on this page.

Table I
MATERIALS TESTED

Lubricant	*Meets Government Spec.*	*Type of Product*	*Approx. Dropping Point, °F*
Grease A	MIL-L-3545 (Superseding AN-G-5a)	Na Soap; Petroleum	406
Grease B		Na Soap; Synthetic Esther	408
Grease C		Li Soap; Polyglycol Ether Fluid	402
Grease D		Carbon-Thickened Silicone Fluid	500+
Grease E		MoS_2 in Thickened Carrier	500+
Grease F		Clay/Amine-Thickened Silicone Fluid	500+
Grease G	MIL-G-15719 (Ships)	Li Soap;Silicone Fluid	429
Grease H	MIL-G-3278	Li Soap; Diester	360
Grease I		Arylurea-Thickened Silicone Fluid	500+
Grease J		Cu Phthalocyanine-Thickened Silicone Fluid	500+
Grease J1		Cu Phthalocyanine-Thickened Silicone Fluid	500+

tion, if any, which each meets. These lubricants were selected[8] for testing on the basis of known or anticipated ability to lubricate conventional anti-friction bearings at high temperatures and to provide data on a wide range of lubricant compositions.

Grease H, meeting specification MIL-G-3278, was of particular interest; at the time this work was initiated, greases meeting specification MIL-G-3278 were the only ones specified for use in USAF aircraft control bearings. Therefore, it was of particular interest to ascertain the high temperature performance of this type of product in conjunction with the KP-16A bearings then in common use.

As it might have been anticipated, the test results varied with temperature, lubricant, and seals.

The following discussion of test results is broken down according to the type of seals used, because of the great importance of this factor at high temperatures. However, for convenient reference, the tabulations shown in the appendix are arranged so that all of the data on any one grease are shown in one table. The effect of temperature and seal material on grease performance is therefore easily observed.

1. *Plya-seals*

Tests with KP-16A bearings and plya-seals were conducted on all the lubricants except greases I and JI. Results are shown in Tables II, III, IV, V and VII in the appendix.

All of the greases tested at 350°F. (greases A, B, C, D and H, met the original requirement of permitting 72,000 oscillation cycles (120 operating hours) without failure, although in all cases these elastomer seals tended to become hard and brittle.

The above-mentioned greases and greases G and J were tested at 400°F. At this temperature all greases except grease B (synthetic ester type) and grease H (MIL-G-3278 grease) permitted 72,000 oscillation cycles (120 hours) in each run without failure. Grease B completed 120 hours in one run and failed at 60 and 76 hours in two other runs. Grease H completed two runs and failed at 58 hours in one run.

Seal deterioration was much greater at 400°F. than at 350°F. At the higher temperature some of the seal units became so brittle that they crumbled when touched. In some cases the bearings were found completely dry at the end of the test, revealing the ineffectiveness of the seals in retaining grease at these temperatures.

At 400° F., greases D, G and J, the silicone greases, were the only ones which remained soft and oily at the end of the test. The other greases either leaked out of the bearings or else became hard and dry.

All of the greases except I[9] and J1[9] were tested at 500°F. with plya-seals. None of them met the objective of permitting 72,000 oscillation cycles without failure[10]. The results are shown as Bar Graph I, facing. Grease F(clay-amine thickened silicone fluid) showed the best performance under these conditions, permitting runs of 28 and 32 hours duration. Grease E, G, H and J all failed in four hours and the others permitted various intermediate test durations.

Silicone greases D, F and J were the only ones which retained any oiliness.. Seal deterioration increased with the length of the test.

On the basis of the work discussed above using

8. Certain ones were made available as CRC cooperative samples.

9. Obtained later in the program—tested with more heat-resistant seals.

10. Because tests on this unit were run at 720 oscillation cycles per hour, this would have been equivalent to 100 hours of operation. See footnote 6, page 17.

elastomer plya-seals, the following points are evident:

a. Satisfactory operation under the test conditions could be obtained for several high temperature greases at temperatures of 350°F. and 400°F.

b. Several of the synthetic type greases appeared to be good lubricants at temperatures up to 400°F.

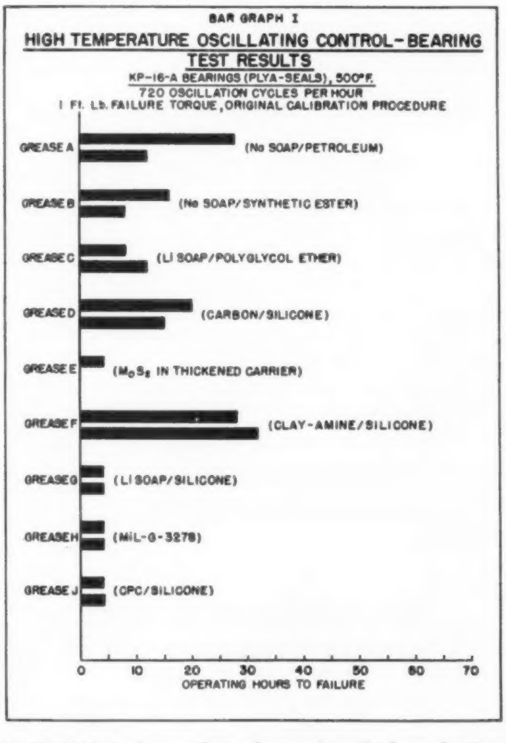
c. None of the lubricants tested gave satisfactory life at 500°F. with these seals.

d. Lubricant failure occurred either by leakage from the bearing or by jamming the bearing with residues resulting from thermal deterioration.

2. *Teflon Seals*

The foregoing section brings out that in order to obtain satisfactory bearing operation at temperatures of 500°F. and higher, improved seals would be necessary. The first attempt at improvement was in the use of teflon[11] seals provided by the Fafnir Bearing company.

Greases G (Li soap/silicone fluid) and H (MIL-G-3278) were each tested at 400°F. and 500°F. with



BAR GRAPH I shows that clay-amine thickened silicone fluid, shown as grease F, made the best performance under the condition of 500 F with plya-seals, permitting runs of 28 and 32 hours duration. Note variations in the others.

the teflon seals. Results, shown in Tables IV and V of the appendix, were little different from those obtained with plya-seals. After a short period of service, the seals curled away from the inner race and permitted grease to leak out. As a result, it was concluded that the teflon seals were no improvement over plya-seals.

3. *Teflon-Fiberglas Seals*

Although the teflon seals curled away from the bearings, they remained soft and pliable at 400-500°F. The Fafnir Bearing company then provided seals made frome a fiberglas base impregnated with teflon to provide more stiffness and stability at these high temperatures. Tests were run with greases G, H, I and J1 at 400°F., 450°F. and 500°F. In every case the seals were like new at the end of the test, and their use made it possible to differentiate betwen lubricants at higher temperatures by allowing the tests to continue to failure.

At 400°F., grease G (Li soap/silicone fluid) gave good performance, grease H (MIL-G-3278) was borderline good, and grease I (arylurea/silicone fluid) was erratic with test durations of 33 hours to failure in one case and 291 hours without failure in another run. Grease I was also tested at 450° F. and failures occurred at 8 and 24 hours in two hours.

Greases G, H, I and J1 were tested at 500°F. These results are summarized in Bar Graph II, facing. While all of these results are not directly comparable to previous data because of a change in the torque calibration procedure[12], it is apparent that grease J1 gave very good performance and grease G and grease I were poor. Grease H, which appeared to be borderline at 400°F., gave reasonably good performance at 500°F. in one run which lasted 112 hours. While Table V indicates that this MIL-G-3278 grease was reduced to a carbonaceous powder at the end of the run, the residue was such that it did not jam or score the bearing sufficiently to cause early failure.

4. *Metal-Sealed MRC K-16-ALL-11 Bearings*

Through CRC cooperation, several sets of prepacked bearings with steel seals were made available by the Marlin-Rockwell corporation for testing. The greases used with these bearings were G, I and J1. These rigid metal seals appeared to be very effective and on the basis of the performance of grease I, were indicated to be superior to the teflon-fiberglas seals.

Bar Graph III, summarizes the results of the tests of the three greases in metal sealed bearings at 500°F.

Each of these three greases was also tested at tem-

11. Polytetrafluoroethylene type.

12. See page 12, "Revised Procedure."

peratures below 500°F. with relatively good results. In addition, two runs were made with the steel-sealed bearings on grease J1 at 550°F. One run failed after 24 hours while the second lasted 80 hours. These results, in contrast to the good results obtained at 500°F., indicate that even with a very heat-stable lubricant, bearing performance under the conditions of these tests is sharply degraded when excessive temperatures are encountered. However, it is encouraging that even 24-80 hours of operation at 550°F. was obtainable with bearings made from conventional steel.

5. *Metal-Sealed Bearings Versus Teflon-Fiberglas Seals*

A comparison of the results of these tests with those conducted with teflon-fiberglas seals is rather interesting; however, it must be borne in mind that the KP-16A and K-16-ALL-11 bearings used were not designed to run at temperatures of 400-550°F., and therefore the comparisons drawn may be somewhat invalid because of fortuitous or erratic bearing behavior. Grease G (Li soap/silicone fluid) was not satisfactory at 500°F. with any of the seals, indicating that a good seal cannot compensate for an inadequate lubricant.

The tests of grease I (arylurea/silicone fluid) with the metal-sealed bearings at 500°F. gave erratic but relatively good performance, while the same grease gave poor performance at 500°F. with teflon-fiberglas seals. This suggests that grease I is critical of sealing and can provide good service when kept in the bearing.

Grease J1 provided tests of slightly longer duration with the metal-sealed bearings than with teflon-fiberglas, and gave very good service at 500°F.

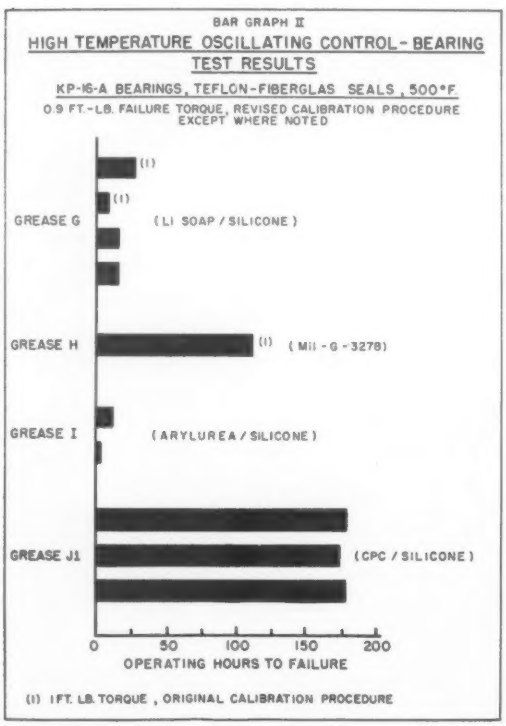
Conclusions

On the basis of the work presented in this paper, the following conclusions are drawn:

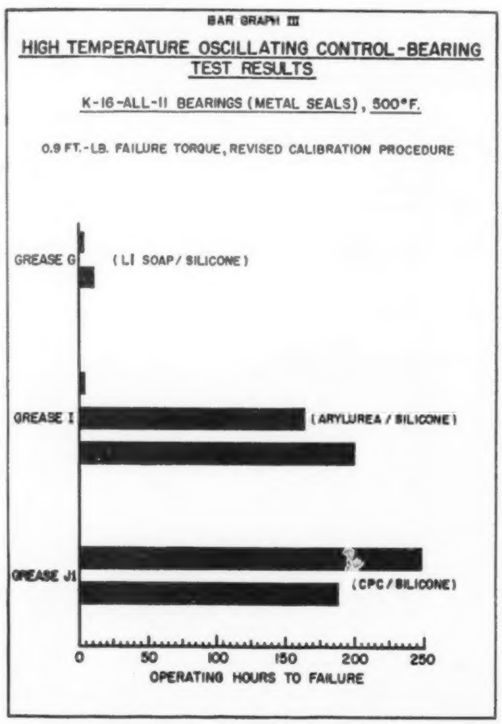
1. A tester simulating aircraft control bearing operation has been operated successfully over a bearing temperature range of 350°F. to 550°F.

2. Erratic results obtained with some greases may be attributed to melting or excessive softening of the lubricant at the test temperature and consequent seepage past seals, leaving variable amounts of residues in the bearings.

3. Seals of special heat-resistant materials are indicated for use at the high temperatures (400-550°F.) investigated.



BAR GRAPH II shows results of greases G, H, I and J1 when tested at 500 F. Grease J1 gave very good performance.



BAR GRAPH III. Greases used with metal sealed bearings for testing at 500 F were grease G, I, and J1. Note grease I.

a. Elastomer seals and teflon seals were unsatisfactory.

b. Teflon-fiberglas and metal seals were effective.

4. Certain solid (non-soap) thickened/silicone fluid greases gave very good performance at 550°F. when run using heat-resistant seals, and encouraging performance was obtained with one of these at 550°F.

Acknowledgements

The data and designs presented in this paper are the result of the efforts of many people. The authors wish to acknowledge the contributions of their previous and present associates in the products application department at Texaco Research Center[13], particularly to Mr. E. W. Herbek, Jr., Mr. F. P. Glazier and Mr. J. D. Lindstrom.

Appreciation is also expressed to the members of the CLR Airframe Lubricants Group, laboratory panel on high temperature grease testing, and the subpanel on oscillating control bearing testers, including the military associates of these groups, for their encouragements, contributions of ideas and materials for testing, and to the CRC for authorizing the publication of the test results.

APPENDIX

Details of Original Tester

A side-by-side interior view of the oven and test bearing assembly is shown in Figure 2.

Figure 3 shows details of the bearing housing arrangement. Two 220-volt heaters (I), maximum output 2500 watts, are capable of maintaining test bearing temperatures up to 600°F. as measured by thermocouple (K) located on the outer ring of the test bearing. The test bearing (L) fits into the receptacle formed by the test bearing housing (M) and the test bearing housing cover (N). This assembly is mounted by means of a press fit inside the inner ring (O) of a Fafnir MM 212 KS bearing with special brass retainer (P) fabricated at Texaco Research Center. A nipple was also brazed on to the self-aligning outer ring (Q) for loading purposes. The entire assembly is mounted on shaft (F) and locked in place by bearing lock (R). Loading rod (S) is fastened to the self-aligning ring of the torque bearing by means of a pin through the yoke and nipple arrangement and permits a 200-pound dead-weight radial load to be applied to the test bearing.

A torque rod (T) clamps to the inner ring of the torque bearing and transmits the torque developed in the test bearing to two spring-loaded micro-switches which are located on the underside of the table surface supporting the test unit. The spring-loaded micro-switches may be preset to any desired torque cut-off and will automatically shut down the entire test unit the instant that test bearing torque exceeds the preset value.

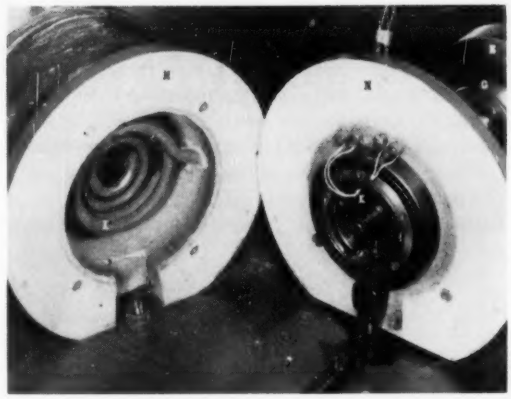


FIGURE 2. A side-by-side interior view of the oven and test bearing assembly for high temperature oscillating control.

Figure 4 shows the spring-loaded micro-switches in regard to both mechanical and electrical operation; also shown are the various other controlling components of the test apparatus. A time clock has been included in the electrical circuit to automatically turn the test unit cyclically on and off.

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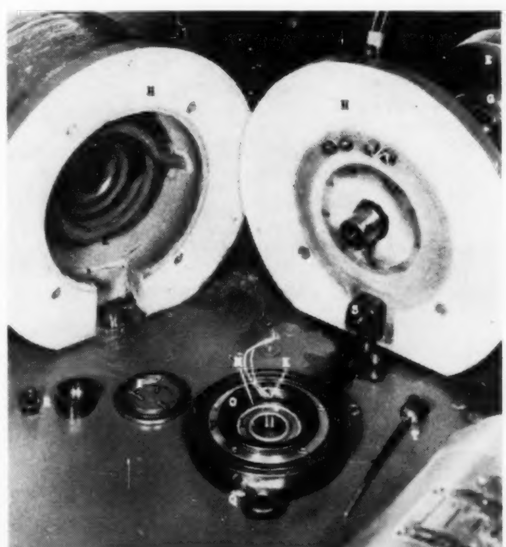


FIGURE 3. Details of the bearing housing arrangement. Note the two 220-volt heaters shown at left by Figure 1.

13. The Texas company, Beacon, New York.

The Modified High Temperature Oscillating Control Bearing Tester

In an effort to obtain better repeatability, an easier and more rapid means of assembly and disassembly, and better temperature control, modifications have been made in the design of the high temperature oscillating control bearing tester. The following figures illustrate the new test unit:

Figure 5—Assembly of oscillating control bearing tester.

Figure 6—Details of oscillating control bearing tester.

Figure 7—Details of housing for oscillating control bearing tester.

It will be noted that the design changes concern only the oven and heating elements, the bearing holder assembly, the method of loading the test bearing, and the micro-switch arrangement. The power source, including the speedranger, gear box, crank arm, fly-

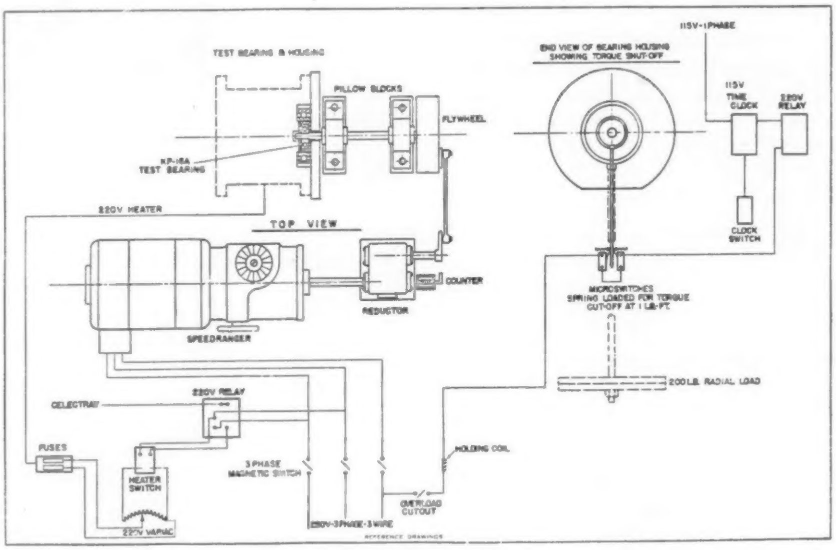


FIGURE 4 shows the spring-loaded micro switches in regard to both mechanical and electrical operation. A time clock has been included in electrical circuit.

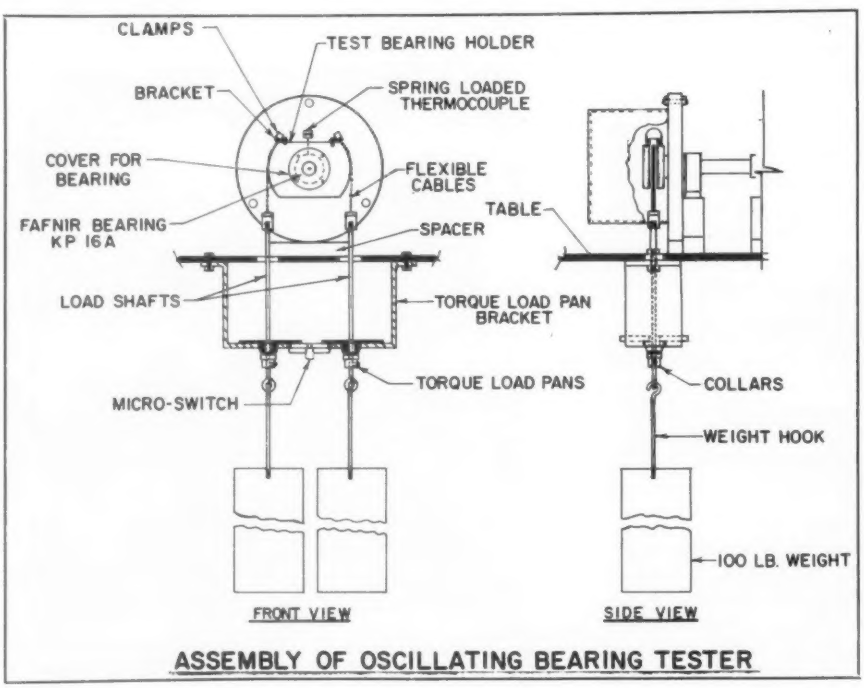


FIGURE 5. The assembly of the oscillating control bearing tester with description of the various parts is given here with both a front and side view. Temperature of the test bearing may be obtained by inserting a thermocouple through the hole provided for that purpose in top of the test bearing housing. Load is supplied by two 100-pound weights suspended from either side of bearing housing.

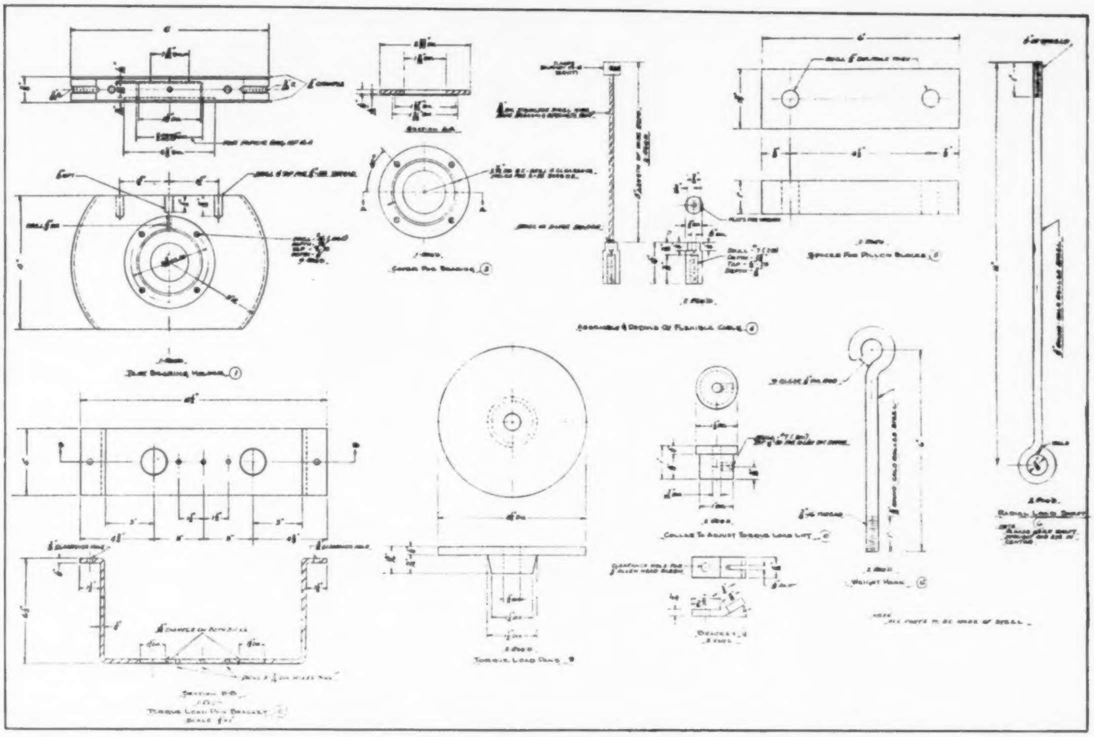


FIGURE 6 shows details of oscillating control bearing tester, showing modification made in the design in an effort to obtain better repeatability, an easier and more rapid means of assembly and disassembly, and better temperature control testing.

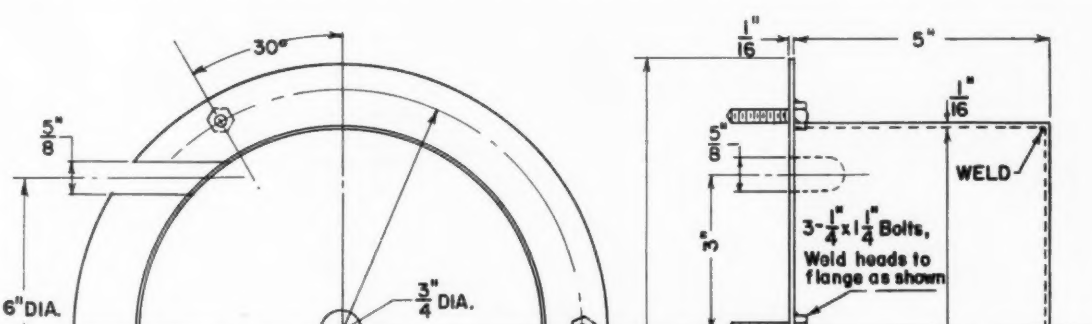


FIGURE 7 gives the details of the housing for the oscillating control bearing test, constructed of number 16 gage steel.

wheel, shaft, and pillow blocks remain unchanged.

The new design provides for a test housing, or oven, constructed of No. 16 gage steel and insulated with 1.25 inches of asbestos cement. It contains 500-watt and 750-watt heating coils and is equipped with a Fenwal thermostat for temperature control. The test bearing holder is a one-piece steel block which contains a recess for the test bearing[14]. A cover plate fits over the test bearing after it is in place. The temperature of the test bearing may be obtained by inserting a thermocouple through the hole provided for that purpose in the top of the test bearing housing. The load is supplied by two 100-pound weights suspended from either side of the test bearing housing.

Attached to each weight hook is a collar which, when sufficient torque is produced by the test bearing, lifts either of the torque load pans from its normal position, thereby tripping the micro-switch and terminating the test. The weight of these torque load pans is determined by the torque failure criteria

Table II

HIGH TEMPERATURE OSCILLATING CONTROL BEARING TEST RESULTS

KP-16A Bearings; Plya-Seals

Failure: 1 Ft.-Lb. Torque; Original Calibration Procedure

Lubricant	*Temp. °F.*	*Test Duration Oscillation Cycles*	*Hours*	*Results*	*Remarks*	*Condition of Seals*
Grease A	350	72,000*	100	No Failure	Bearing free turning; Grease black but oily, some hardening.	Hard but some flexibility left.
Grease A	350	72,000†	100	No Failure	Same as above.	Same as above.
Grease A	400	72,000	120	No Failure	Bearing stiff Grease dry, black, hard.	Very brittle.
Grease A	400	72,000	120	No Failure	Same as above.	Hard but some flexibility left.
Grease A	500	19,870†	28	Failed	Bearing seized; Grease black, dry, carbonaceous.	Very brittle.
Grease A	500	8,516†	12	Failed	Same as above	Very brittle.
Grease B	350	72,000	120	No Failure	Bearing free turning; Grease soft, oily.	Hard but some flexibility left.
Grease B	350	72,065	120	No Failure	Bearing slightly rough; Grease harder but oily.	Brittle.
Grease B	400	35,742	60	Failed	Bearing seized; Grease black, dry, carbonaceous.	Very brittle.
Grease B	400	45,583	76	Failed	Bearing seized; Grease black, dry, carbonaceous.	Very brittle.
Grease B	400	72,000	120	No Failure	Bearing rough; Grease hard, black, dry.	Very brittle.
Grease B	500	11,549†	16	Failed	Bearing seized; Grease black, dry, carbonaceous.	Very brittle.
Grease B	500	5,585†	8	Failed	Same as above.	Hard but some flexibility left.

*Run on Machine No. 1 at a speed of 720 oscillation cycles/hour.

†Run on Machine No. 2 at a speed of 720 oscillation cycles/hour.

of the test[15] Thus, calibration is not required prior to each test run. The balanced load and torque load pan arrangement assures constant adjustment. Should a different torque failure criterion be desired, it is only necessary to add (or subtract) the required weight to the torque load pans.

With this new arrangement, it is an easy matter to obtain time-torque data; that is, the torque build-up within the test bearing with respect to time. Weights may be added, in small increments, to either of the suspended loads (100-pound weights) until the micro-switch is tripped. The torque failure criterion less the torque caused by the additional weights, gives the torque being produced by the test bearing at that instant. This procedure can be repeated at intervals as desired to obtain a time-torque curve. Such data should prove of interest and value.

Table III

HIGH TEMPERATURE OSCILLATING CONTROL BEARING TEST RESULTS

KP-16A Bearings; Plya-Seals

Failure: 1 Ft.-Lb. Torque; Original Calibration Procedure

Lubricant	*Temp. °F.*	*Test Duration Oscillation Cycles*	*Hours*	*Results*	*Remarks*	*Condition of Seals*
Grease C	350	72,000	120	No Failure	Bearing very rough; Grease black, dry, little remained.	Very brittle.
Grease C	350	72,000	120	No Failure	Same as above.	Very brittle.
Grease C	400	73,865	123	No Failure	Bearing very rough; No grease remained.	Very brittle, crumbled on touch.
Grease C	400	72,000	120	No Failure	Same as above.	Same as above.
Grease C	500	5,617*	8	Failed	Bearing seized; Grease black, dry, carbonaceous.	Hard but flexible.
Grease C	500	8,499*	12	Failed	Same as above.	Hard but flexible.
Grease D	350	72,000	120	No Failure	Bearing free turning; Grease soft, oily.	Brittle.
Grease D	400	73,846	123	No Failure	Bearing stiff; Grease tending to harden but still somewhat oily.	Very brittle, one crack.
Grease D	400	72,073	120	No Failure	Same as above.	Very brittle.
Grease D	500	14,155*	20	Failed	Bearing seized; Grease gritty but oily.	Very brittle.
Grease D	500	11,005*	15	Failed	Same as above.	Very brittle.
Grease E	500*	2,820	4	Failed	Bearing seized; Grease soft, oily around bearing; Grease on ball paths, hard.	Soft and flexible.
Grease F	500*	19,777	28	Failed	Bearing seized; Grease oily but rubbery.	Brittle.
Grease F	500*	22,576	32	Failed	Bearing seized; Grease oily but rubbery.	Brittle.

*Run on Machine No. 2 at a speed of 720 oscillation cycles/hour.

14. KP-16A or other K-16 bearing. This bearing is a press-fit into the recess.

15. Our present torque failure criterion is 0.9 ft.-lb. Since the lever arm distance (radius of the test bearing holder) is three inches, our torque load pans weight 3.60 pounds.

Table IV
HIGH TEMPERATURE OSCILLATING CONTROL BEARING RESULTS
Grease G (Lithium Soap, Silicone Fluid)

Temp. °F.	Bearing	Seals	Failure Torque Ft.-Lb.	Torque Calibration Procedure	Test Duration: Oscillation Cycles	Test Duration: Hours	Result	Condition of Bearing	Condition of Grease	Condition of Seals
400	KP-16A	Plya-seals	1.0	Original	72,000	120	No failure	Free turning	Soft, oily	Very brittle
400	KP-16A	Plya-seals	1.0	Original	72,000	120	No failure	Stiff	Dry, hard	Very brittle
400	KP-16A	Plya-seals	1.0	Original	72,413	120	No failure	Rough, stiff	Black, rubbery to hard	Brittle
400	KP-16A	Plya-seals	1.0	Original	72,000	120	No failure	Rough in spots	Same as above	Brittle
400	KP-16A	Teflon	1.0	Original	72,042	120	No failure	Free turning	Dry but soft	Soft, flexible Curled away from inner race.
400	KP-16A	Teflon	1.0	Original	72,046	120	No failure	Free turning	Dry but soft	Same as above
400	KP-16A	Teflon-Fiberglas	1.0	Original	71,818	120	No failure	Hard turning	Rubbery, slightly oily	Like new
400	KP-16A	Same as above	1.0	Original	72,081	120	No failure	Same as above		Like new
400	KP-16A	(Teflon-	1.0	Revised	93,573	156	Failure	Seized	Dark Rubbery	Like new
400	KP-16A	(Fiberglas	1.0	Revised	302,400[a]	504	Failure	Seized		
400	K-16-ALL-11	Metal	0.9	Revised	117,272	196	No failure	-	Soft	-
400	K-16-ALL-11	Metal	0.9	Revised	117,280[a]	196	No failure	Smooth	Soft	-
450	K-16-ALL-11	Metal	0.9	Revised	136,819	228	Failure	Seized	Dry	-
450	K-16-ALL-11	Metal	0.9	Revised	103,321	172	Failure	Seized	Dry, hard	-
450	K-16-ALL-11	Metal	0.9	Revised	21,591[a]	36	Failure	Seized	Dry, hard	-
450	K-16-ALL-11	Metal	0.9	Revised	98,325[a]	164	Failure	Seized	Dry, hard	-
500	KP-16A	Plya-seals	1.0	Original	2822[b]	4	Failure	Seized	Dry	Hard
500	KP-16A	Plya-seals	1.0	Original	2800[b]	4	Failure	Seized	Dry	Soft, flexible
500	KP-16A	Plya-seals	1.0	Original	2405	4	Failure	Seized	Hard, dry	Brittle
500	KP-16A	Plya-seals	1.0	Original	17,037	28	Failure	Seized	Hard, dry	Brittle
500	KP-16A	Teflon	1.0	Original	2323	4	Failure	Seized	Powdered	Harder, broken
500	KP-16A	Teflon	1.0	Original	14,375	24	Failure	Seized	Hard, dry	(Flexible,
500	KP-16A	Teflon	1.0	Original	26,714	44	Failure	Seized	Hard, granular	(Curled away (from inner race
500	KP-16A	(Teflon-	1.0	Original	16,935	28	Failure	Seized	Rubbery to hard	Like new
500	KP-16A	(Fiberglas	1.0	Original	5,153	8	Failure	Seized	Rubbery to hard	Like new
500	KP-16A	(Teflon-	0.9	Revised	9607	16	Failure	Seized	Hard, dry	-
500	KP-16A	(Fiberglas	0.9	Revised	9591	16	Failure	Seized	Hard, dry	-
500	K-16-ALL-11	Metal	0.9	Revised	2380	4	Failure	-	Dry, crumbly	-
500	K-16-ALL-11	Metal	0.9	Revised	7188	12	Failure	-	Dry, crumbly	-

[a]Run on Machine No. 2
[b]Run on Machine No. 2 at 720 oscillation cycles per hour.

Table V
HIGH TEMPERATURE OSCILLATING CONTROL BEARING TEST RESULTS
Grease H (Lithium Soap, Diester)
Failure 1 ft.-lb. Torque (Original Calibration Procedure)

Temp. °F.	Bearing	Seals	Test Duration: Oscillation Cycles	Test Duration: Hours	Result	Condition of Bearing	Condition of Grease	Condition of Seals
350	KP-16A	Plya-seals	72,000	120	No failure	Rough	Dry and hard	Hard, brittle
350	KP-16A	Plya-seals	72,000	120	No failure	Rough	Dry and hard	Hard, slightly flexible
400	KP-16A	Plya-seals	34,869	58	Failure	Seized, dry	None remaining	Hard, brittle, cracked
400	KP-16A	Plya-seals	72,113	120	Failure	Seized, dry	None remaining	Hard, brittle, crumbled on touch
400	KP-16A	Plya-seals	72,000	120	No failure	Very rough, dry	None remaining	Very brittle, crumbled on touch
400	KP-16A	Teflon	16,667	27	Failure	Seized	Black, hard, dry	Soft, flexible; curled away from inner race
400	KP-16A	Teflon	17,076	28	Failure	Seized	Black, hard, dry	Soft, flexible; curled away from inner race
400	KP-16A	Teflon-Fiberglas	72,000	120	No failure	Very hard turning, rough	Little remained, carbonaceous powder	Like new
400	KP-16A	Teflon-Fiberglas	65,342	108	Failure	Seized	Little remained, carbonaceous powder	Like new
500	KP-16A	Plya-seals	2939[a]	4	Failure	Seized	Chunks of carbonaceous grease; balls slightly oily	Hard, slightly flexible
500	KP-16A	Plya-seals	2810[a]	4	Failure	Seized	Chunks of carbonaceous grease; balls slightly oily	Brittle
500	KP-16A	Teflon	4652	8	Failure	Seized	Black, hard, dry	Soft, flexible; curled away from inner race
500	KP-16A	Teflon	4650	8	Failure	Seized	Black, hard, dry	Soft, flexible; curled away from inner race
500	KP-16A	Teflon-Fiberglas	66,162	112	Failure	Seized	Little remained, carbonaceous powder	Like new

[a]Run at 720 oscillation cycles per hour.

Table VI

HIGH TEMPERATURE OSCILLATING CONTROL BEARING TEST RESULTS

Grease I (Arylurea; Silicone Fluid)

Failure Torque: 0.9 ft.-lb. (Revised Calibration Procedure)

Temp. °F.	Bearing	Seals	Test Duration Oscillation Cycles	Test Duration Hours	Result	Condition of Bearing	Condition of Grease
400	KP-16A	Teflon-Fiberglas	19,605	33	Failed	Rough; smoothed when turned	Soft, oily
400	KP-16A	Teflon-Fiberglas	174,532	291	No failure	Turns easily, rough	Soft, oily
400	K-16-ALL-11	Metal	7230	12	Failed	Seized	Soft
400	K-16-ALL-11	Metal	112,277	183	Failed	Seized	Soft
400	K-16-ALL-11	Metal	156,033	260	No failure	-	Oily
450	KP-16A	Teflon-Fiberglas	14,139	24	Failed	Seized	Soft
450	KP-16A	Teflon-Fiberglas	4870	8	Failed	Seized	Soft
450	K-16-ALL-11	Metal	151,513	252	No failure	Slightly rough	Dry
450	K-16-ALL-11	Metal	151,502	252	No failure	Free, smooth	Dry
500	KP-16A	Teflon-Fiberglas	7339	12	Failed	Seized	Soft
500	KP-16A	Teflon-Fiberglas	2639	4	Failed	Seized	Soft, oily
500	K-16-ALL-11	Metal	2526	4	Failed	Seized	Soft
500	K-16-ALL-11	Metal	100,951	164	Failed	Seized	Dry, powdered residues
500	K-16-ALL-11	Metal	120,096	200	Failed	Seized	Oily

Table VII

HIGH TEMPERATURE OSCILLATING CONTROL BEARING TEST RESULTS

Greases J and J1 (Cu Phthalocyanine, Silicone Fluid)

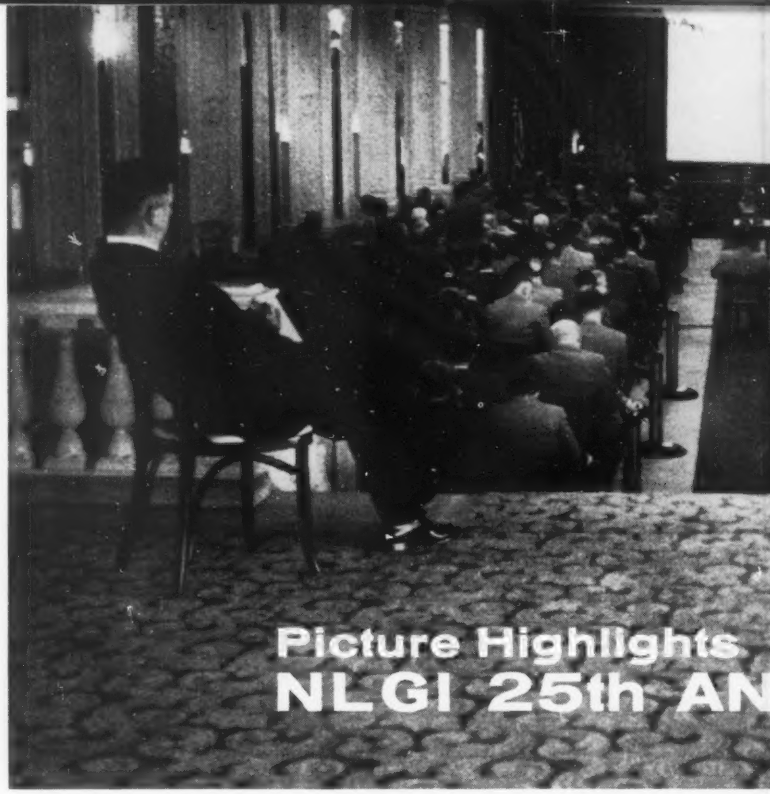
Grease	Temp. °F.	Bearing	Seals	Failure Torque Ft.-Lb.	Torque Calibration Procedure	Test Duration Oscillation Cycles	Test Duration Hours	Result	Condition of Bearing	Condition of Grease	Condition of Seals
J	400	KP-16A	Plya-seals	1.0	Original	72,000	120	No failure	Free turning	Soft, oily	Hard, slightly brittle
J	400	KP-16A	Plya-seals	1.0	Original	72,000	120	No failure	Free turning	Soft, oily	Very brittle
J	500	KP-16A	Plya-seals	1.0	Original	2844	4	Failed	Seized	Soft, oily	Flexible
J	500	KP-16A	Plya-seals	1.0	Original	2866	4	Failed	Seized	Soft, oily	Flexible
J1	450	K-16-ALL-11	Metal	0.9	Revised	151,880	252	No failure	Turns hard, smooth	Soft, oily	-
J1	500	K-16-ALL-11	Metal	0.9	Revised	148,610	248	Failed	Seized	Rubbery	-
J1	500	K-16-ALL-11	Metal	0.9	Revised	112,780	188	Failed	Seized	Rubbery to hard	-
J1	500	KP-16A	Teflon-Fiberglas	0.9	Revised	108,207	180	Failed	Seized	Dry	-
J1	500	KP-16A	Teflon-Fiberglas	0.9	Revised	105,861	176	Failed	Seized	Rubbery lumps	-
J1	500	KP-16A	Teflon-Fiberglas	0.9	Revised	108,207	180	Failed	Seized	Dry	-
J1	550	K-16-ALL-11	Metal	0.9	Revised	14,420	24	Failed	Seized	Dry	-
J1	550	K-16-ALL-11	Metal	0.9	Revised	48,017	80	Failed	Seized	Rubbery residue	-

D. C. McGAHEY's *experience in lubrication began with a part time job at Pennsylvania state university's engineering experiment station during his senior year in 1951. After graduation he was assigned to Texas company's research center where his work has included application testing of LPG gasoline, diesel fuels, crankcase oils, transmission fluids, greases and industrial lubricants. He is group leader of industrial oils testing.*

About the Authors

R. S. BARNETT *has been with the Texaco Research Center since he joined the Texas company in 1931. He has been concerned with lubricating grease applications, research and analysis with considerable field work and supervisory experience. His title is chemist, technical services managerial staff. A graduate of Southwestern Louisiana Institute, he received an M. S. from New York U. He belongs to many NLGI and ASTM panels.*

IMMEDIATE Past President J. W. Lane summed up a year of achievement, noted record growth in activities and services for the Grease Institute.

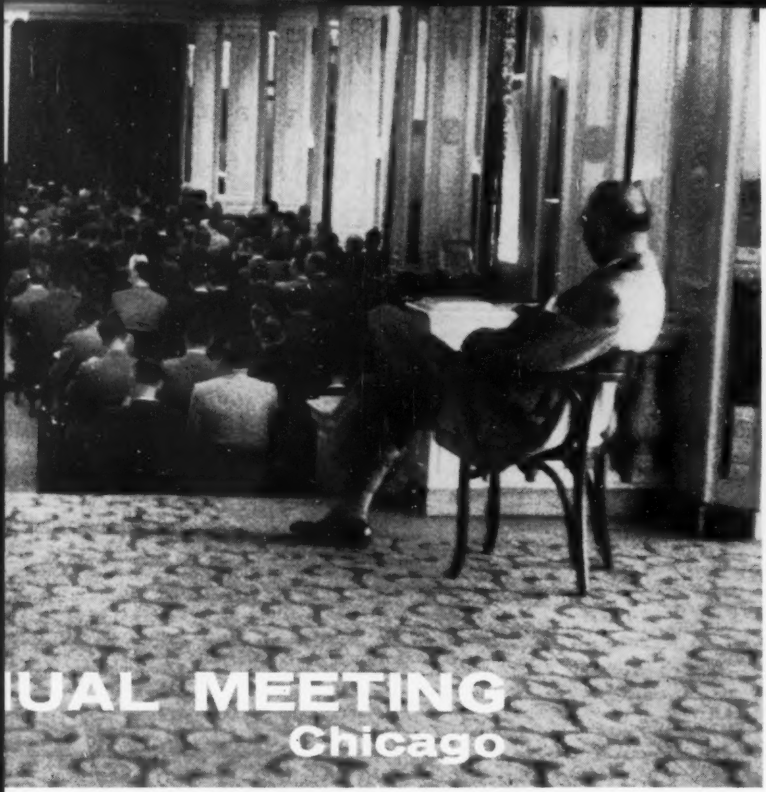


October 28-30 Session Has Ma

Marks Excellent Beginning o st

CELEBRATION OF anniversaries is always pleasant and the October 28-30 meeting of the National Lubricating Grease Institute was particularly so—not only was NLGI embarking on its Silver Anniversary year ("twenty-five years *young*," as one member put it) but those in attendance could see and hear a list of accomplishments which heightened the story of growth and accomplishment since the foundation in 1933. Busy meeting rooms and corridors of the Edgewater Beach hotel, traditional annual meeting spot of NLGI for many years, also found a group not content to rest on past accomplishments but busy formulating new projects and services to the industry. Highlights of the three-day gathering included the premiere of the new movie, "Grease, the Magic Film," finalization of the timing for the lubricating grease produc-

1957-58's new officers: F. E. Rosenstiehl is vice-president; A. J. Daniel is treasurer; R. Cubicciotti is president. Both Daniel and Rosenstiehl were elected to the NLGI Board of Directors for three-year terms.



PRESIDENT-Elect R. Cubicciotti gave a forecast of still further accomplishment as the scope of NLGI interests and services grow and enlarge.

Many Interesting Presentations—

nstitute's Silver Anniversary Year

tion survey on 1957's figures, establishment of a new Technical sub-committee on fundamental research, an excellent staged drama on marketing with props and speaking parts, the award of NLGI's seventh Honorary Membership to M. B. Chittick (see page 32), and the announcement that the interests of the Institute could be considered to include the field of gear lubricants. How does the organization stack up? There are record highs in membership, finances are in good shape, services and projects are growing, and more important . . . there are further plans to implement all that has gone before. An annual meeting thus serves as a check point to observe progress, in addition to the papers, discussions, contacts and friendships business offered. In respect to progress, in the opinion of many, it was one of the finest meetings held since the series began.

MEMBERS of the Board of Directors elected at the Annual Business Meeting include (left) B.G. Symon, H.P. Ferguson, G. A. Olsen and W. H. Saunders, Jr. They were elected to three-year terms on the Institute's governing body.

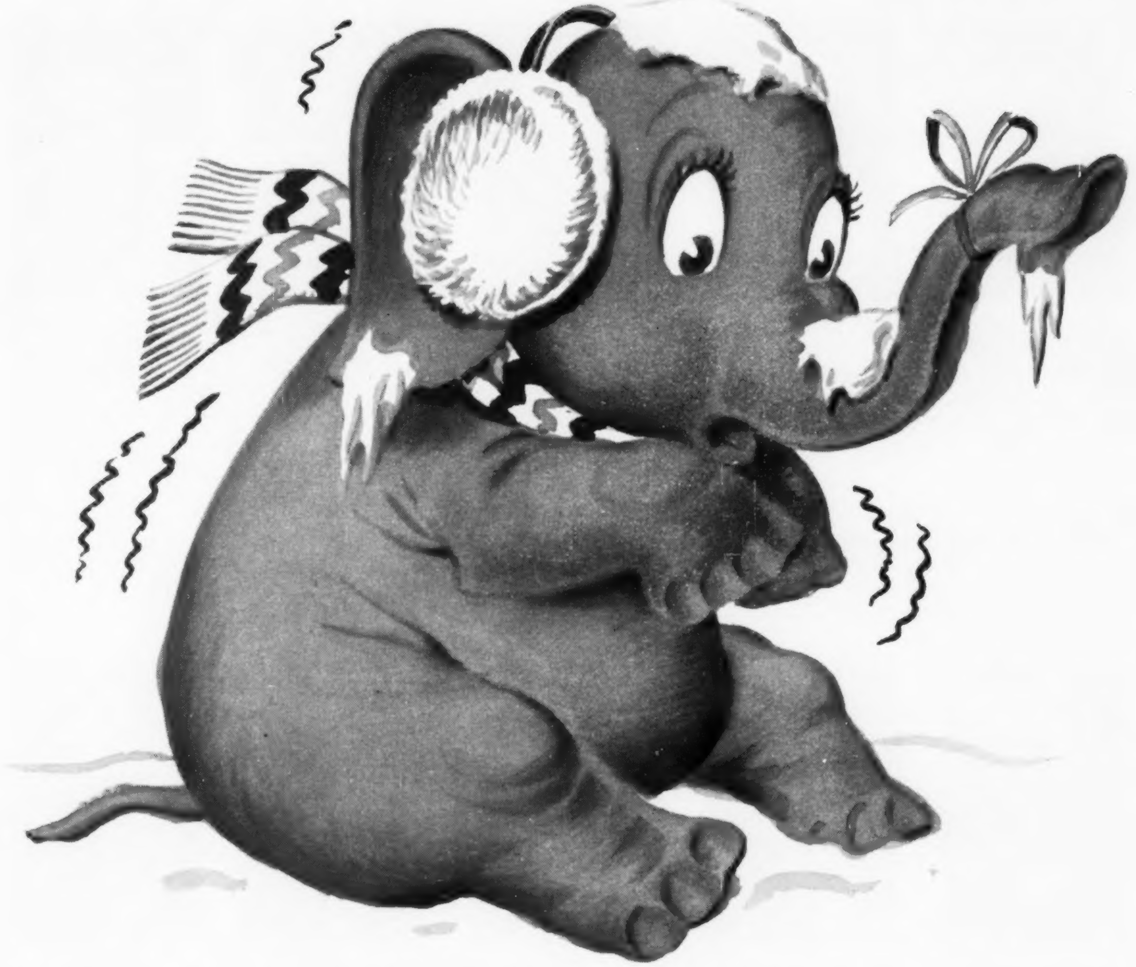
INDUSTRY award winners G. W. Miller and T. G. Roehner receive engraved sterling trays. Awards were made in 1952, this form of recognition adopted in later years.

PREMIERE of NLGI movie "Grease, the Magic Film" is shown to a full house. More than 53 prints of the picture have been sold to members and friends of the industry.

LEFT, Treasurer A. J. Daniel, re-elected to his sixth consecutive term in this office reports at Annual Business Meeting, "The NLGI financial picture is good."

WELL received, the innovation of a dramatic stage enactment of marketing concepts, complete the large cast, scene changes and elaborate set and props.

ANNUAL banquet climaxed business activities as J. W. Lane (r.), immediate past president, prepares to turn gavel over to successor R. Cubicciotti (left, seated), the 1958 president elect and the NLGI's twenty-fifth chief executive.



An elephant seldom forgets. However, this little fellow seems to have forgotten, winter will soon be here. Have you? Automobiles, farm equipment and industrial machinery need winter lube protection. However, there's no need to market a whole line of "special" winter lubricating greases, when Bat's offer the highest quality, Multi-Purpose Lubricating Grease available.

BEATS COLD

Just the right "body" for pumping, at any time of the year. Provides efficient lube protection well below freezing.

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Multi-Purpose Grease is rated "excellent." Does not "work down" in the toughest lubrication jobs.

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Never softens from heat or runs from bearings. Gives perfect lubrication at higher temperatures.

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Technical Committee

E. W. ADAMS
Research Fellowship

C. J. BONER
Procurement of Technical Papers

G. ENTWISTLE
Editorial Review

W. J. EUBANK
Definition of Terms

NLGI 25th Anniversary

The NLGI Technical Committee chairman and the eight sub committee chairmen for 1957 were photographed as they reported their positions at the twenty-fifth annual meeting, and spoke of projects for the coming year.

The research fellowship student, sponsored by NLGI (below, far right), reported on work he is doing at Utah U.

G. KAUFMAN
Characteristics of Dispensing Equipment

J. J. KOLFENBACH
Fundamental Research

P. V. TOFFOLI, JR.
Recommended Practices for Packing Front Wheel Bearings

H. C. ZWEIFEL
NLGI Classification of Lubricating Greases

S. J. HAHN
NLGI Fellowship Student

Chittick Wins Honorary Award

In the previous history of the National Lubricating Grease Institute six men have been chosen to receive Honorary Memberships for their outstanding service to the organization over a period of years. This year the recipient of the honor was Colonel Martin B. Chittick, one of the founders of the Institute. The presentation was made at the Annual Meeting.

Colonel Chittick was the second president of NLGI, serving in 1934-1935. Beginning his term on the board of directors from the time of its formation in 1933, he remained a director until 1942. Chittick was for many years the chairman of the NLGI Technical Committee and it was under his jurisdiction that the NLGI classification system for lubricating greases was established. This classification system has since received international recognition and acceptance.

Chittick is the only man to receive both the Honorary Membership award and the NLGI "Award to Industry." He was the 1956 winner of the industry award.

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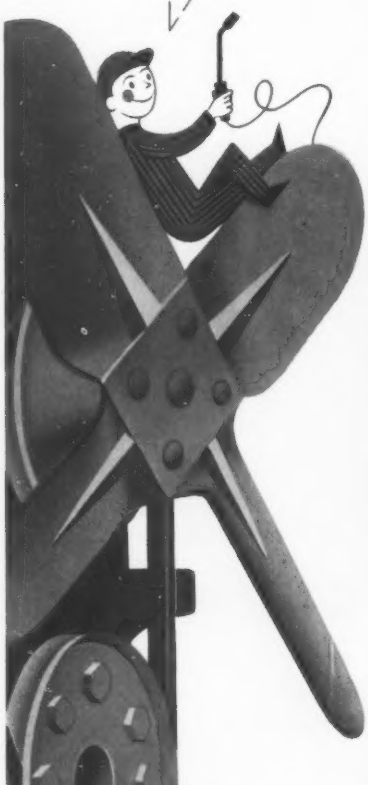

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NLGI 25th Annual Meeting

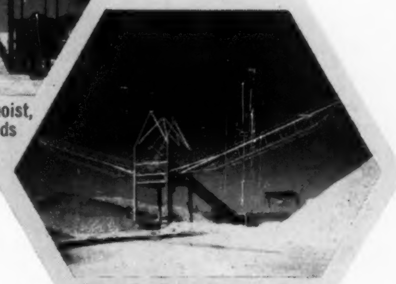
RIGHT—Preprints of papers presented during the meeting get heavy play as members browse, make their selections.

BELOW—Registration, a chance to see program, note who is already there, and chat a moment with old friends.

BETWEEN meetings, informal discussions, exchange of ideas, spark program.

"In 14 months...not a single bearing lubrication failure with lithium-base grease!"

Conveyor-stacker handling moist, sticky material which builds up on the rollers.



Ore unloading conveyor rollers handling 200 tons of ore per hour.

THE PROOF IS IN THE PERFORMANCE...

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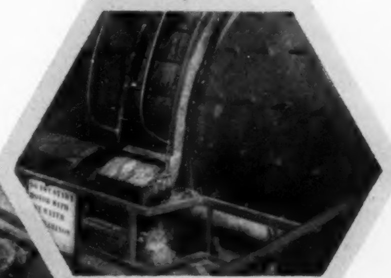
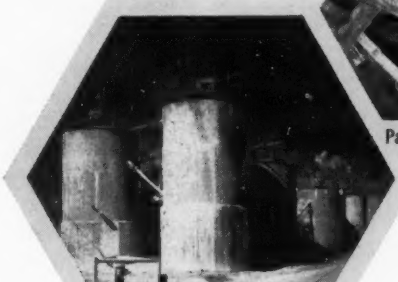
and does it better!



Pinion gear transmitting power from 600 h.p. motor to a ball mill.

Pan Conveyor handling hot clinker (1600°F), roller bearings in dusty, moist atmosphere.



Leach tanks handling hot slurry, agitators driven by Falk gear reducing units.

V.A. Wemco classifier, part of wet grinding system, lower bearing submerged in hot sludge.

Here's a report of our own experience with lithium-base grease under extreme industrial service conditions. Approximately 95% of the grease used in the plant of AMERICAN LITHIUM CHEMICALS, Inc., our subsidiary at San Antonio, Texas, is lithium-base, one-type grease. In fourteen months operation we have not been able to trace a single cause for bearing failure to the lubricant used. The on-the-spot photos above give graphic evidence of the rugged bearing service requirements in this plant where lithium ores are processed into high-grade lithium hydroxide, itself an important ingredient in lithium-base grease. Performance like this is why grease chemists, manufacturers, marketers and users all attest to the superiority of lithium-base . . . the *one* grease in place of *many* for efficient and economical operation.

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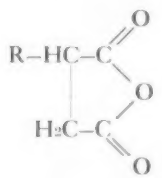
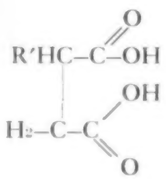
Patents and Developments

Silica-Thickened Greases Containing Succinic Acid Derivatives

U. S. Patent 2,805,994 issued to H. J. Liehe and W. L. Hayne, Jr., assigned to Standard Oil company (Indiana). Rust preventive properties are imparted to silica-thickened greases by incorporating therein certain alkyl or alkenyl derivatives of succinic acid or anhydride having the following empirical formulae:





Wherein R and R's are acyclic hydrocarbon radicals containing from 5-15 carbon atoms, including compounds such as octenyl succinic anhydride and dodecenyl succinic anhydride, in amounts preferably of 0.2% to 1.5% by weight. Addition of an oil soluble emulsifier, e.g., pentaerythritol mono-oleate (Pentamul 126) and an oiliness agent, e.g., C_{12} dialkyl phosphate (Ortholeum 162) show considerable improvement in rust prevention.

Lubricating Grease Compositions from OXO Reaction Products

U. S. Patent 2,801,970 issued to J. H. Bartlett, A. J. Morway and J. C. Munday, assigned to Esso Research and Engineering company, Lubricating grease compositions are claimed comprising mixtures of acetals derived from the Oxo stage product of the Oxo process, thickened to a grease consistency with a grease-forming soap. These actetals may be thickened with complex lithium soaps of co-neutralized hydrogenated fish oil acids and glacial acetic acid claimed

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to give excellent in the A.F.B.M.A. bearing test. A flow sheet of the process employed is shown in Figure 1.

Lubricating Greases thickened with Soaps Obtained by Alkali Fusion of Amino Alcohols

U. S. Patent 2,801,969 issued to A. J. Morway and J. H. Bartlett, assigned to Esso Research and Engineering company. Grease thickeners are obtained by fusing high molecular weight amino derivatives having a primary alcohol group (e.g, amino ether alcohols), with caustic alkali, producing a metal soap from the amino acid so formed, and incorporating this into a lubricating oil in grease-making proportions. Fusion is conducted with NaOH or KOH at 500°-575° F., with the following reaction taking place:

$$E.\,CH_2CH_2OH + MOH \rightarrow 2H_2 + E.\,CH_2COOM$$

Wherein E is an amino ether radical containing one or more carbon atoms, and M is the alkali metal. Examples of suitable amino compounds include ethylaminobis (decaethoxyethanol), laurylamino-bis (tetrapropoxytetraethoxyethanol), cyclohexylamino-bis (decaethoxyethanol), monoethylamino-decaproxypropanol, toluino-pentadecaethoxyethanol, di-coco-amino-

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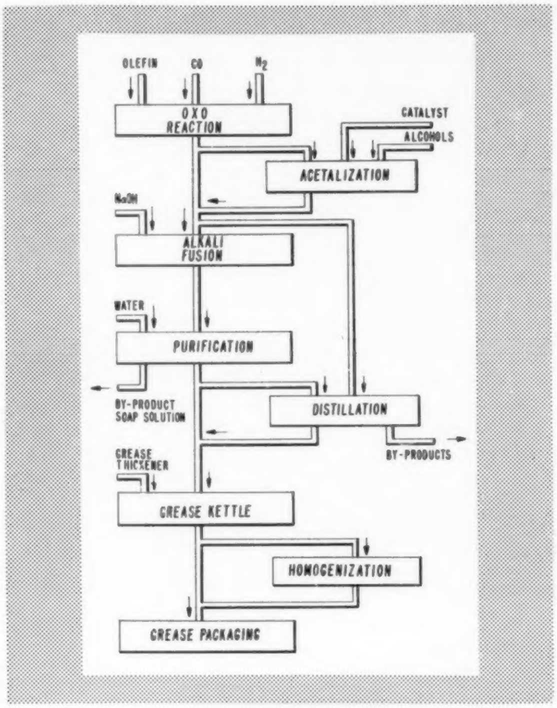
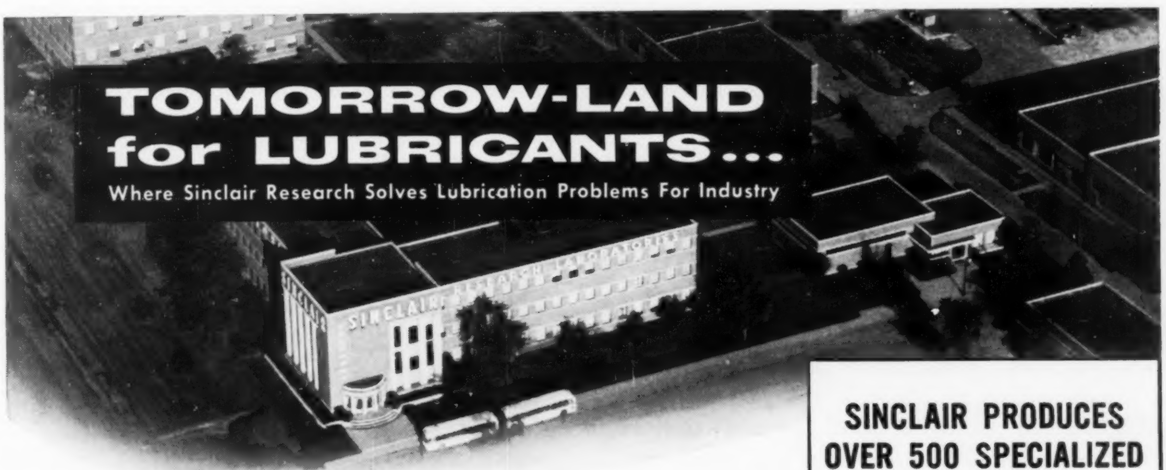


FIGURE 1 shows a flow sheet of the test process used.



Located at Harvey, Illinois, is one of the most extensive installations of its kind in the world—Sinclair Research Laboratories. These facilities are an important part of Sinclair's investment in the future. Here is where Sinclair engineers and chemists work to develop new products and improve the quality of existing ones. At these famous laboratories were developed the Sinclair lubricants now solving difficult problems in all branches of industry. If you have a special lubrication problem, write today to Sinclair Refining Company, Technical Service Division, 600 Fifth Avenue, New York 20, N. Y.

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ethanol, etc. The fusion product may be used advantageously with alkali metal fatty acid soaps particularly in conjunction with low molecular weight fatty acid salts (complexes).

Complex Lubricating Grease

U. S. Patent 2,799,656 issued to L. A. Mikeska, J. H. Bartlett and A. J. Morway, issigned to Esso Research and Engineering company. Outstanding high temperature properties and structure stability are assigned to a grease composition prepared by thickening lubricating oil base stock with a mixture (5%-15%) of the alkali or alkaline earth metal soaps of a high molecular weight fatty acid (1 mol), a low molecular weight acid (1 mol), and the saponification product of an ester of a formal ether acid (2%-20%). The latter product is an alkali metal soap of a material having the formula:

$$RZCH(OC_nH_{2n})_x\, ZR'COOR''$$

Wherein R is an aliphatic alkyl group containing 4-30 carbon atoms, R' is a divalent hydrocarbon radical, R" is an alkyl group containing 1-5 carbon atoms, Z is oxygen or sulfur, and $_x$ is 0-20. Preferred materials are ethers formed by reacting alphachloromethyl ethers with esters or ether esters of hydroxy acids (glycolic, lactic, hydroxy butyric, etc.)

Greases from Monohydric Alcohol Esters of Hydroxy Fatty Acids

U. S. Patent 2,801,220 issued to M. K. Smith and assigned to the Baker Castor Oil company. In cases where the soap component is made in the presence of the lubricating base (in situ formation), it is possible to produce the gelling agent from mono-hydric alcohol esters of hydroxy fatty acids, e.g., methyl 12-hydroxystearate, methyl ricinoleate, methyl hydroxypelargonate, methyl 11-hydroxy-9-undecenoate, etc. In most cases, there is no advantage in using alcohols other than methanol in forming the esters to be employed. The greases of the patent are produced by a fusion process in which metal compounds are caused to react with the esters in presence of the unsaponifiable material which is to serve as the base for the final grease. One example specifies: Saponifiable material 12 weight percent, Lithium hydroxide 1.68%, Phenyl alphanaphthylamine 0.5%, and Mineral oil 85.82%.

Other Patents

U. S. Patent 2,801,776 (Glen R. Morton) Grease gun filler pump.

U. S. Patent 2,805,797 (C. J. Neuman) Grease guns. ■

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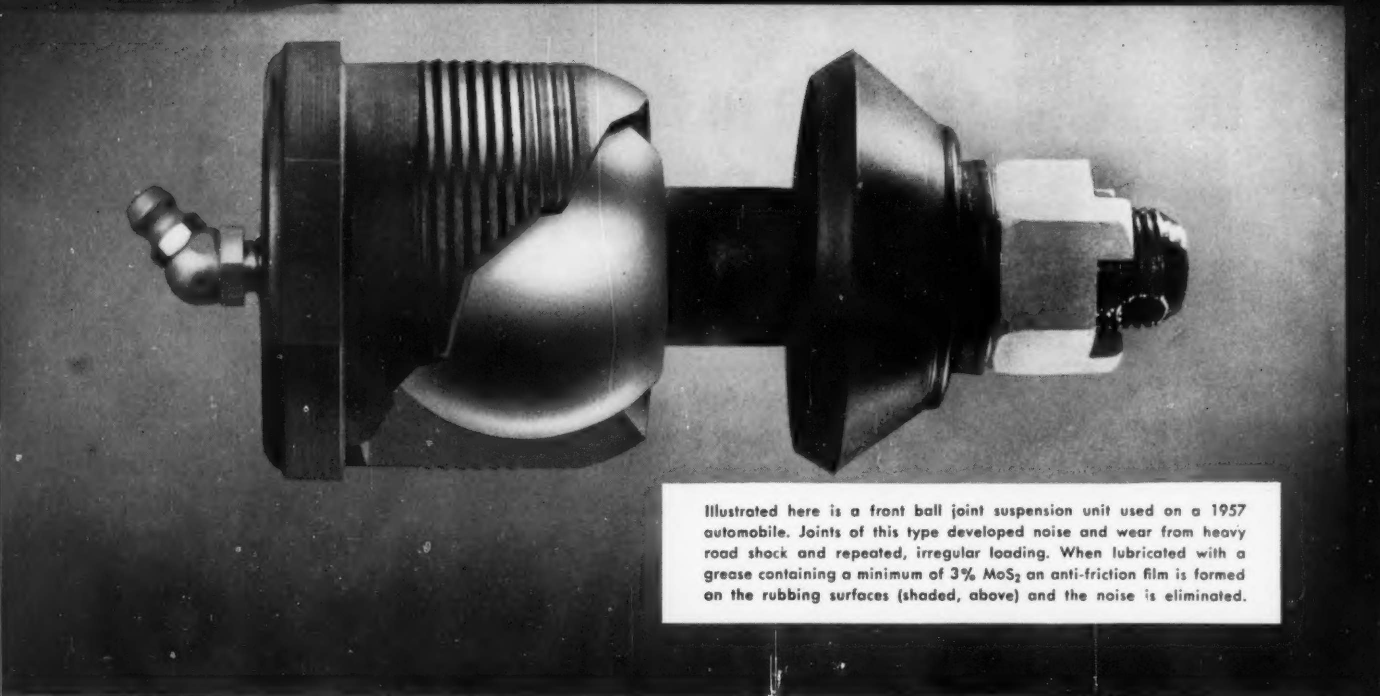
120 North Adams Hutchinson, Kansas



Illustrated here is a front ball joint suspension unit used on a 1957 automobile. Joints of this type developed noise and wear from heavy road shock and repeated, irregular loading. When lubricated with a grease containing a minimum of 3% MoS_2 an anti-friction film is formed on the rubbing surfaces (shaded, above) and the noise is eliminated.

When bearing surfaces are stripped of lubricants by SHOCK LOADING, OSCILLATION or RECIPROCATION . . .

MOLY-SULFIDE additive extends effective lubrication

Serious lubrication problems are often set up by extreme pressures, shock loading, oscillation and certain forms of reciprocating motion. Conventional lubricants may be forced out of the bearing area or wiped off the bearing surface. Then something more than a standard grease is required.

In situations of this kind, grease containing Moly-Sulfide proves its great value. MoS_2 is forced between the rubbing surfaces, adheres to the metal and forms a protective film that prevents galling, welding and fretting. The extent to which MoS_2 sustains lubrication is demonstrated by substantial reduction in wear, and is borne out by field reports from many different industries.

4 specific cases show advantages of MoS_2 for industry

Avoids splitting in steel punching. For example, while punching ⅝" holes in ½" thick hot rolled steel it was found that splitting of the plate frequently occurred between two adjacent holes, or toward the edge of the plate. This trouble, a result of heavy shock loading, was eliminated by brushing punches with lubricant containing MoS_2.

Makes excellent break-in lubricant for rocker arms. For break-in runs of engines, one of the major automobile manufacturers uses a supplemental MoS_2 grease on rocker arm pivots. The MoS_2 provides a low-friction film when the base lubricants wipe off under oscillating motion. This prevents galling and scoring of the mating surfaces.

Gives smooth travel to 4-ton grinding head. On a heavy cylindrical grinder the 4-ton head moves on the ways in a jumpy fashion, resulting in damage to the work. Use of a lubricant containing MoS_2 results in smooth, precise travel.

Serves well where lubricant cannot be resupplied. Moly-Sulfide is now widely used for lubricating such hard-to-reach points in automobiles as convertible top mechanisms, power operated windows and seat adjusters. Applied at assembly, the MoS_2 extends lubrication and greatly reduces noise and wear.

Many manufacturers now producing MoS_2 greases

Moly-Sulfide greases are available from many producers today. For a list of the manufacturers of these greases (Lu-2a) – which includes several major oil companies – and for a copy of "Molybdenum Disulfide as a Grease Additive" (Lu-17) write to Department 58, Climax Molybdenum Company, 500 Fifth Avenue, New York 36, N. Y.

People in the Industry

Barber Elected Elco Lubricant's President

The Elco Lubricant corporation, Cleveland, announces the election of D. R. Barber as president and general manager. Mr. Barber is a graduate of the Harvard Business school and has had varied selling and administrative experience in the chemical and electronics fields.

William Cox, Jr., who has been with the company since its inception in 1929, continues as vice president and will also serve as chairman of the board of directors. H. W. Niemeier, with the company since 1936, continues as secretary-treasurer.

Nopco Appoints New Technical Sales Representative

Walter B. Morehouse, vice president in charge of sales for the Nopco Chemical company's industrial division, has announced the appointment of William F. Dolan, Jr., as technical sales representative in North Carolina and the eastern part of Tennessee.

Mr. Dolan, a graduate of Alabama Polytechnic Institute, has been with Nopco's textile chemicals division since 1955. He is a member of Phi Psi, Tau Beta Pi, and Sigma Nu fraternities.

In his new position, Mr. Dolan will be handling sales of Nopco's complete line of processing chemicals including such products as esters, ethylene oxide condensates, amides, metallic soaps, sulfonates, water soluble polymers, and resin and wax emulsions.

Vulcan Names Ferguson Vice President Sales

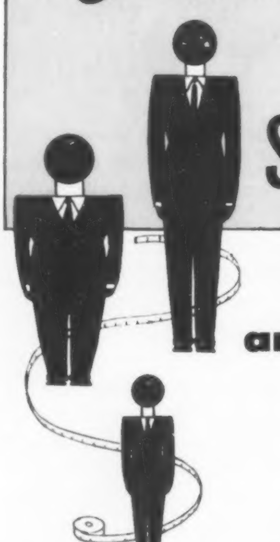
Vulcan Containers Inc., steel shipping drum and pail manufacturer, announced the appointment of Lawrence M. Ferguson, sales manager, as vice president for sales, according to Vern I. McCarthy, president. Ferguson succeeds Herbert B. Scharbach who resigned, effective November 15.

Vulcan also announced that Eu-

Continued next page

Custom-Made

TO YOUR SPECIFICATIONS!



LUBRICANTS and COMPOUNDS

manufactured to your exact formula and packed in your containers. New, enlarged, modern facilities speed production.

AMERICAN LUBRICANTS INC.
Independent Wholesale and Industrial Producers
1575 CLINTON ST., BUFFALO 6, N. Y. *Since 1922*

LET US MODERNIZE YOUR PLANT

C. W. NOFSINGER CO.

Petroleum and Chemical Engineers

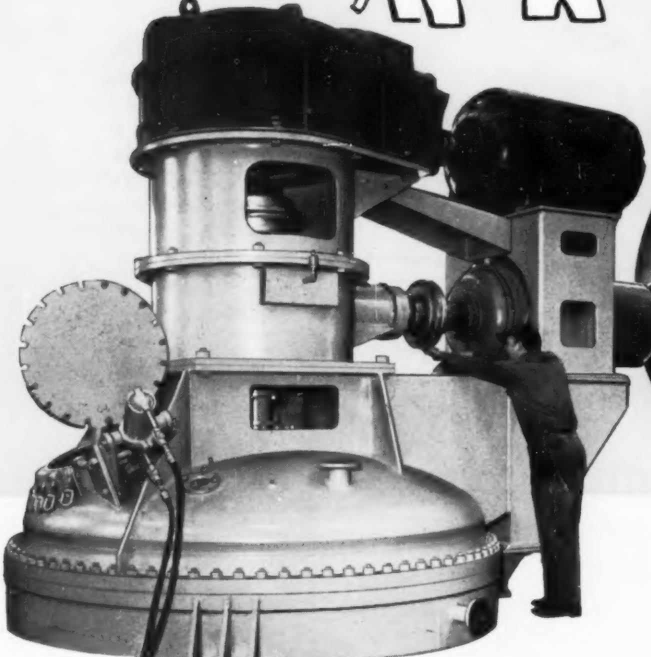
906 GRAND AVENUE
KANSAS CITY 6, MO.

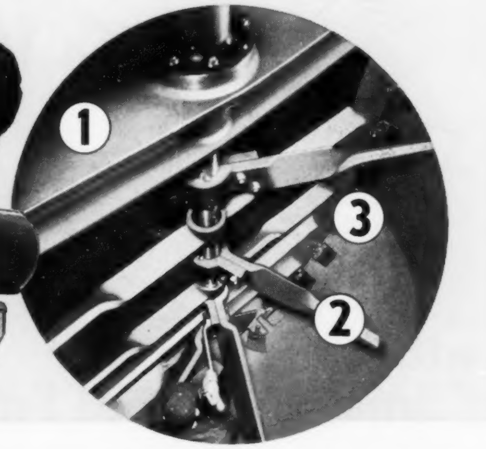
"In Engineering it's the People that count"

Today's Best Answer to

Better GREASE MIXING!

Struthers Wells SUPER POWER thru DOUBLE MOTION





1 Heavy duty scraper frame and paddle arms permit maximum horsepower input.

2 Counter-rotating de-stratifying arms of extra heavy construction to handle super power.

3 Hinged scraper blades contact and clean 98% of kettle interior for maximum heat transfer.

This Struthers Wells Grease Kettle represents a new design principle that permits heavy horsepower input up to 200 hp and employs counter-rotating de-stratifying arms that give *double motion* mixing. Hinged scraper blades contact 98% of the inside surface—assure maximum heat transfer. Let Struthers Wells apply this peak efficiency to a Grease Kettle design for your requirements.

STRUTHERS WELLS PRODUCTS

PROCESSING EQUIPMENT DIVISION

Crystallizers . . . Direct Fired Heaters . . . Evaporators . . . Heat Exchangers . . . Mixing and Blending Units . . . Quick Opening Doors . . . Special Carbon and Alloy Processing Vessels . . . Synthesis Converters

BOILER DIVISION

BOILERS for Power and Heat . . . High and Low Pressure . . . Water Tube . . . Fire Tube . . . Package Units

FORGE DIVISION

Crankshafts . . . Pressure Vessels . . . Hydraulic Cylinders . . . Shafting . . . Straightening and Back-up Rolls

STRUTHERS WELLS *Corporation*

Struthers Wells

WARREN, PA.

Plants at Warren, Pa. and Titusville, Pa.

Offices in Principal Cities

gene W. Gehm, senior sales representative for the past eleven years, has been appointed assistant sales manager.

Joining the Bellwood, Ill., firm nineteen years ago, Ferguson became assistant sales manager in 1950 and sales manager in 1956.

Ferguson has represented the 41-year-old pioneer metal container manufacturer in all major markets in the United States and was instrumental in developing Vulcan's market in Canada prior to the establishment of Vulcan Containers, Limited in Toronto in 1953, McCarthy said.

Ferguson also has had an important role in the development of Vulcan's unique ready-for-shipment inventory of 100,000 pails, enabling Vulcan to meet its customer manufacturers special container packaging requirements and production emergencies. He also has helped direct Vulcan's expanded research program in the development of special interior linings for metal containers.

The Bellwood firm's steel container and tin can divisions produce a wide variety of steel packaging for the chemical, paint, food, adhesives, printing ink and petroleum products industries. Vulcan recently expanded its facilities to include production of 55-gallon drums.

Emery Creates Customer Service Position

Orville W. B'Hymer has been promoted to the newly created position of customer service manager for the fatty acid sales department of Emery Industries, Inc., G. W. Boyd, department sales manager, announced.

B'Hymer will coordinate customer relations in a move designed, according to Boyd, to afford more individualized attention and service for customers of Emery's line of fatty acids. The line includes stearic and oleic acids, animal and vegetable fatty acids, hydrogenated fatty acids and glycerides and castor oil derivatives.

B'Hymer has served as assistant to the sales manager since joining Emery in 1947. He attended the University of Cincinnati evening college.

no shocks

with

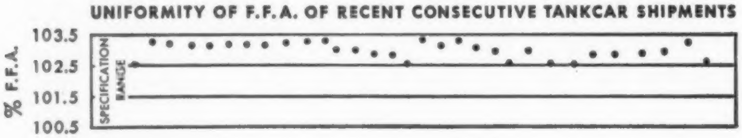
Emery® Animal Fatty Acids

...because each shipment performs like previous ones

Mr. Greasemaker: Emery Animal Fatty Acids hold no shocking surprises...every shipment performs exactly like the one before and high quality is assured. This is illustrated in the uniformity of the free fatty acid content of consecutive recent shipments of Emery 531 Animal Fatty Acid shown below.

If you are aware of the high cost of frequent formulation adjustments, you know the value of consistent performing raw materials in your greases. Since Emery 531 Animal Fatty Acids cost no more than competitive grades, why not benefit from these advantages and always buy the Emery brand. Write Dept. E-12 for specifications and samples.

UNIFORMITY OF F.F.A. OF RECENT CONSECUTIVE TANKCAR SHIPMENTS



Emery Fatty Acid Sales Dept.

Emery Industries, Inc., Carew Tower, Cincinnati 2, Ohio

New York • Philadelphia • Lowell, Mass.
Chicago • San Francisco • Cleveland
Ecclestone Chemical Co., Detroit
Warehouse stocks also in St. Louis, Buffalo, Baltimore and Los Angeles
Export: Carew Tower, Cincinnati 2, Ohio
In Canada: Emery Industries (Canada) Ltd., 639 Nelson St., London, Ontario

FOR THE MANUFACTURE OF GREASES THAT DELIVER

Top Performance...

USE

GULF QUALITY STOCK OILS

GULF

A COMPLETE line of stock oils, quickly available to you through strategically located warehouses, terminal facilities, and refineries in 31 states from Maine to New Mexico. Also quality petrolatums.

GULF OIL CORPORATION
2927 GULF BUILDING
PITTSBURGH 30, PA.

Lollis Receives Emery Sales Territory

Robert C. De Lollis has been appointed sales representative for the mid-Atlantic sales territory of Emery Industries, Inc., G. W. Boyd, sales manager of Emery's fatty acid sales department, announced.

He will handle Emery's complete line of fatty acids, including stearic acid, oleic acid, animal and vegetable fatty acids, hydrogenated fatty acids and glycerides, and caster oil derivatives.

De Lollis' territory includes central and northeastern Pennsylvania, northern New Jersey, western Maryland and central New York state. He succeeds P. N. Leech, who recently was transferred to Emery's Chicago office.

De Lollis is a graduate of Harvard university and has taken graduate work at the University of Chicago.

G. W. Miller, Founder of American Lubricants

The October issue of the NLGI SPOKESMAN contained a news story about how American Lubricants, Inc. had expanded their Niagara Frontier plant and the author mistakenly listed the name of the founder and first president. To correct the omission it should be stated that George W. Miller was the founder and first president. Mr. Miller is also the holder of an NLGI "Award to Industry" trophy and was secretary of NLGI for seven years.

SWIFT'S INDUSTRIAL OILS INVITE COMPARISON

Write for a trial order of any of these Swift quality products . . . a trial in your own shop will convince you of their stability and dependability in helping to produce lighter and more uniform lubricants.

SWIFT & COMPANY
TECHNICAL PROD. DEPT.
1842 165th St.,
Hammond, Indiana

RED OILS • STEARIC ACIDS • LARD OILS • SPERM OILS • TALLOWS • HYDROGENATED CASTOR OILS, GLYCERIDES, & FATTY ACIDS • METHYL #12-HYDROXYSTEARATE • #12-HYDROXYSTEARIC ACID • VEGETABLE FATTY ACIDS • TALLOW FATTY ACIDS • ACIDLESS TALLOWS

Swift

To Serve Your Industry Better

Atomic Power Lubricating Grease Announced by Shell Oil Co.

Shell Oil company has developed a new radiation-resistant grease which is now commercially available.

The new product, known as Shell APL Grease, is designed for application in nuclear power plants where it will be subject to atomic radiation. It was developed at Shell's Martinez, Calif., research laboratory.

Shell said gamma ray tests have shown that the grease will withstand an accumulated dosage of 1 x 10^9 roentgens. High temperature bearing tests have revealed the grease has excellent thermal stability and lubricity at 300 degrees Fahrenheit.

Static radiation tests were conducted at Shell Development company's Emeryville, Calif., research center. Here the grease was bombarded by one of the most powerful radiation sources in industry—a three-million-volt Van de Graaff electron accelerator.

Idaho Falls Facilities Used

Mechanical stability tests were made in the Atomic Energy commission facilities at Idaho Falls. A roll tester was specially designed to operate in the water shield surrounding the radiation source, which was fission products of spent U-235 fuel rods.

After receiving a total incident dosage of 7.2 x 10^8 roentgens at an average rate of 5.9 x 10^6 roentgens per hour the grease showed no significant deterioration.

By comparison a well established premium quality multipurpose soap base grease failed after a total incident dosage of 8.2 x 10^7 roentgens at an average rate of 9.6 x 10^5 roentgens per hour.

Reynolds Metals Publishes Aluminum Guide

A technical booklet on the use of aluminum for tanks and vessels is now available to interested individuals, business firms and engineering schools.

The booklet prepared by Reynolds Metals company serves as a basic technical guide to design, fabrication and applications of aluminum tanks and vessels. It lists more than 100 general types of chemicals

Continued next page

May We Put Some in Your Hands?

The Century Brand Oleic Acids pictured above have the following properties:

	Century 1050 L P White Oleic Acid	Century 1010 Distilled Oleic Acid
Maximum color, Lovibond	5Y/0.5R—5¼"	15Y/3R—1"
Acid value	197—203	195—201
Saponification value	198—205	197—203
Unsaponifiable content	1.5% max.	2.0% max.
Polyunsaturates	3% max.	

We would like you to see our Oleic Acids and compare them critically with other competitive products, so you may fully appreciate Century Brand quality. We invite your comparison of Century Brand Oleic Acids because only you can realize their advantages in *your* products.

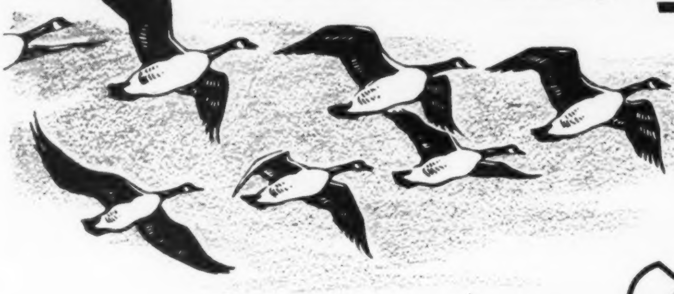
A request to Dept. H-30 for samples will receive prompt attention and we will welcome the opportunity to put these better products in your hands.

HARCHEM CENTURY BRAND

HARCHEM DIVISION

WALLACE & TIERNAN, INC.
25 MAIN STREET, BELLEVILLE 9, NEW JERSEY
IN CANADA: W. C. HARDESTY CO. OF CANADA, LTD., TORONTO

There's only ONE Leader



SOUTHWEST for Good GREASE

TO SERVE YOU

A large, modern, fully integrated, versatile grease manufacturing plant . . .

A fully staffed Research and Control Laboratory . . .

An experienced, progressive, enthusiastic employee and management group . . .

*SERVICE POTENTIAL—UNLIMITED!

FOR YOUR PRIVATE BRANDED LUBRICANT REQUIREMENTS,
SOUTHWEST . . . THE HOUSE OF "GOOD" GREASE

CALL, WIRE, OR WRITE FOR FULL PARTICULARS

SOUTHWEST Good GREASE

SPECIALIZING IN THE CUSTOM MANUFACTURE OF PETROLEUM LUBRICATING GREASES AND SPECIALTIES

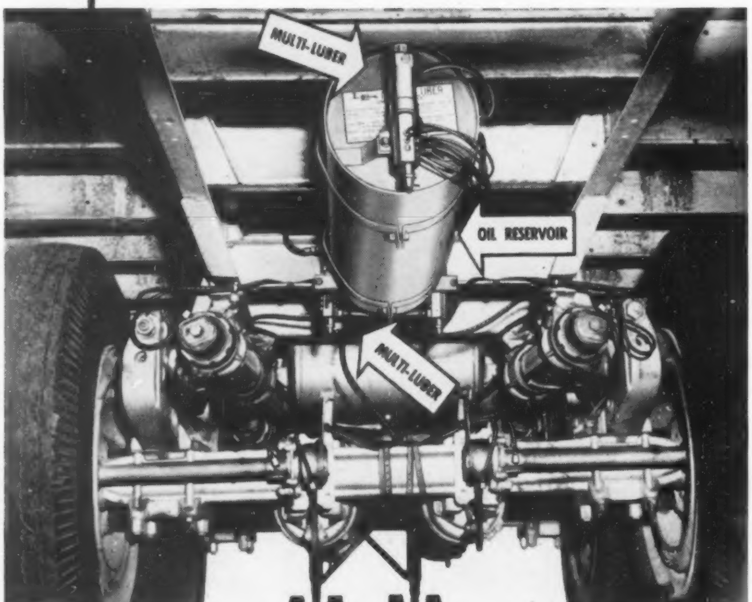
SOUTHWEST GREASE & OIL CO., INC.

220-230 WEST WATERMAN • WICHITA 2, KANSAS

Lincoln FLEET *Multi-Luber**

AUTOMATIC POWER LUBRICATION

Slashes operating and maintenance costs



Air-operated Multi-Luber units mounted on 7-gallon lubricant reservoir, as seen from rear of Freuhauf trailer. Feed lines supply lubricant to axle hanger, bracket assemblies, brake cams and slack adjusters.

Lincoln's Multi-Luber system *automatically* lubricates truck-trailers while they operate . . . doubles or triples the time interval between overhauls . . . and increases net profit per ton mile. Every time brakes are applied, the system cycles, forcing a measured quantity of refinery pure lubricant under high pressure into each bearing.

More than 500 over-the-road fleets are now using Lincoln Multi-Luber. Hundreds of thousands of test miles prove Multi-Luber provides maximum protection against bearing wear . . . smoother vehicle operation . . . elimination of down-time and man-hours for lubrication . . . increased service-life of bearings and moving parts. In fact, the six largest builders of truck-trailers have adopted Lincoln Multi-Luber as a factory-approved, optional accessory!

For complete information, write for Bulletin 532.

Lincoln

THE MOST TRUSTWORTHY NAME IN LUBRICATING EQUIPMENT

*Trade Name Registered

LINCOLN ENGINEERING COMPANY

Division of The McNeil Machine & Engineering Co.

5702-30 Natural Bridge Ave. • St. Louis 20, Mo.

for which aluminum applications are particularly advantageous.

Copies of the booklet, "Reynolds Aluminum for Tanks and Vessels," may be obtained without cost by writing Reynolds Metals company, 2500 S. Third street, Louisville, Ky.

Midland Specialties Booklet Aids Storage

Midland Specialties company is issuing a new catalog, number 41, which describes and illustrates a complete line of equipment necessary for a comprehensive conservation program. This new 32 page catalog has been prepared by Creative Ad Builders. An entire section is devoted to conservation of volatile products in storage, which can be an aid to anyone who stores gasoline or solvents in above ground tanks.

The book also contains information concerning five steps necessary for complete stock loss reduction program. Pertinent facts describe the conservation of chemicals.

For a free copy of catalog number 41, write to Midland Specialties company, 4809 South on Richmond, Chicago 32, Illinois.

Penola Executive Dies

C. Park Hanneman, 51, a vice president and director of the Penola Oil Company, New York, died early November 22 in Norwalk Hospital after a brief illness.

Mr. Hanneman joined Penola, a marketing affiliate of Standard Oil company (N.J.), in 1939 and had been a vice president and director since 1943. Earlier in his career he served with other Jersey Standard affiliates in Panama, Argentina and Great Britain.

A native of Brooklyn, N. Y., he started out with the Jersey Standard organization as a 19-year-old office boy in New York City. He was a member of St. Stephen's Episcopal church of Ridgefield, the Silver Spring Country club and Jerusalem Lodge of the Masons.

Mr. Hanneman is survived by his wife, Mrs. Denise Hanneman, and a daughter, Suzanne, 15.

News continued on page 53

News About NLGI

Lubricating Grease Survey Officially Approved

Final approval of the recommendations made by the NLGI committee investigating the proposed survey of lubricating greases was given at the October 28 Board of Directors meeting in Chicago, during the 25th Annual Meeting. Negotiations have been concluded with a national accounting firm with an excellent record in conducting confidential surveys of the type envisioned by NLGI and mechanics for the operation are being finalized at this writing.

Anonymous Questionnaires Used

An official questionnaire has been developed substantially along the lines shown in earlier issues of the NLGI SPOKESMAN and a time table for the compilation of 1957 production figures has been established. The schedule:

December 2, 1957—NLGI national office to send letter notifying Active membership in the U.S.A. of the mailing of the official questionnaire, with sample.

January 15, 1958—Accounting firm of Ernst & Ernst to mail certified questionnaires with cover letter and enclosed return envelope to Active members.

March 31, 1958—Ernst & Ernst tally and closing date.

Because of the anonymous character of the questionnaires several "blanket" mailings to remind members of the deadline will be sent to all Active firms during the period of the compilation by producers (i.e., questionnaires are not numbered nor marked in any way so that the member completing the questionnaire cannot be identified).

With over three-quarters of the production in this country expected to be accounted for in this first venture, the feeling at the Annual Meeting was that the survey can grow from this modest beginning to the desires of the membership, enlarging in scope and service with each succeeding year.

Details concerning the delivery of the Ernst & Ernst report to the entire NLGI membership in all classifications will be discussed in later issues of the NLGI SPOKESMAN.

NLGI News continued on page 50

almost
Everything that moves
DEPENDS ON GREASE!

Almost everything that moves either in actual operation or in the process of its making . . . from gate hinges to tractor wheels . . . depends upon grease. That is why lubricants should be bought with care. You can always depend upon Deep Rock highest quality greases and lubricants. They are manufactured to give top lubrication to all moving parts.

DEEP ROCK

KERR-McGEE OIL INDUSTRIES, INC.
306 N. ROBINSON • OKLAHOMA CITY
PHONE RE 9-0611

McGEAN 30% LEAD NAPHTHENATE ADDITIVE

Consistently uniform in metallic content and viscosity

Fully clarified by filtration

Non-Oxidizing - - - contains no unsaturated soaps

Free from low flash constituents

your inquiries solicited

THE McGEAN CHEMICAL COMPANY
MIDLAND BUILDING • CLEVELAND 15, OHIO
Detroit • Grand Rapids • Chicago

NLGI Associate, Technical Members

CONTAINER AND CLOSURE MANUFACTURERS

American Can Company
4810 Belleview, Kansas City 12, Mo.
Representative—H. T. Rich

American Flange & Manufacturing Company, Inc.
30 Rockefeller Plaza, New York 20, N. Y.
Representative—Richard L. Parish, Jr.

Bennett Industries
Peotone, Illinois
Representative—S. A. Bennett

Central Can Company
2415 West 19th St., Chicago 8, Illinois
Representative—Henry Frazin

Cleveland Container Company
4925 So. Halsted St., Chicago 9, Ill.
Representative—R. D. Sayles

Continental Can Company, Inc.
100 East 42nd St., New York 17, N. Y.
Representative—W. J. Flint

Geuder, Paeschke & Frey Company
324 North Fifteenth St., Milwaukee 1, Wis.
Representative—Neil Savee

Inland Steel Container Company
6532 South Menard Ave., Chicago 38, Ill.
Representative—J. Daniel Ray

Jones & Laughlin Steel Corporation
Container Division
405 Lexington Ave., New York 17, N. Y.
Representative—C. K. Hubbard

National Steel Container Corp.
6700 South LeClaire Ave., Chicago 38, Ill.
Representative—Henry Rudy

The Ohio Corrugating Company
917 Roanoke Ave. S. E., Warren, Ohio
Representative—Lawrence F. McKay

Republic Steel Corporation
Container Division
465 Walnut Street, Niles, Ohio
Representative—Theodore Humphrey

Rheem Manufacturing Company
400 Park Ave., New York 22, New York
Representative—F. J. Blume

Rieke Metal Products Corporation
Auburn, Indiana
Representative—Mahlon E. Rieke

Steel Package Division of National Lead Company
722 Chestnut Street, St. Louis 1, Missouri
Representative—Warren T. Trask

United States Steel Products
Division, United States Steel Corporation
30 Rockefeller Plaza, New York 20, N.Y.
Representative—Wm. I. Hanrahan

Vulcan Containers, Inc.
P. O. Box 161, Bellwood, Illinois
Representative—H. B. Scharbach

ENGINEERING SERVICES

The C. W. Nofsinger Company
307 East 63rd Street, Kansas City 16, Missouri
Representative—C. W. Nofsinger

MANUFACTURERS OF EQUIPMENT FOR APPLICATION OF LUBRICATING GREASES

Aro Equipment Corporation
Bryan, Ohio
Representative—D. G. Reed

Balcrank, Inc.
Disney near Marburg, Cincinnati 9, Ohio
Representative—Richard P. Field

The Farval Corporation
3249 East 80th St., Cleveland, Ohio
Representative—Lee Witzenburg

Gray Company, Inc.
60 Northeast 11th Ave., Minneapolis 13, Minn.
Representative—B. A. Beaver

Lincoln Engineering Company
5701 Natural Bridge Ave., St. Louis 20, Mo.
Representative—G. A. Hubbard

Stewart-Warner Corporation
Alemite Division
1826 Diversey Parkway, Chicago 14, Illinois
Representative—E. G. Wicklatz

Trabon Engineering Corp.
28815 Aurora Rd., Solon, Ohio
Representative—E. W. Baumgardner

MARKETING ORGANIZATIONS

Ampol Petroleum, Ltd.
Buchanan Street
Balmain, New South Wales, Australia
Representative—Wilfred Gordan Askins

California-Texas Oil Company
380 Madison Ave., New York 17, New York
Representative—Hal U. Fisher

Canadian Petrofina Limited
505 Dorchester Street West
Montreal, Quebec, Canada
Representative—M. E. Wight

Cooperative GLF Exchange, Inc.
Terrace Hill, Ithaca, N. Y.
Representative—W. S. Miller

Denco Petroleum Company
5115 Denison Avenue, Cleveland 2, Ohio
Representative—I. L. Carmichael

D-X Sunray Oil Company
Mid-Continent Bldg., P.O. Box 381, Tulsa, Okla.
Representative—J. W. Basore

Farmer's Union Central Exch., Inc.
P. O. Box G, St. Paul 1, Minnesota
Representative—H. F. Wagner

Illinois Farm Supply Company
100 East Ohio Street, Chicago, Illinois
Representative—S. F. Graham

Ohio Farm Bureau Cooperative Association, Inc.
245 North High Street, Columbus 16, Ohio
Representative—Walter N. Callahan

Valvoline Oil Company
Division of Ashland Oil & Refining Co. Box G
Freedom, Pennsylvania
Representative—D. A. Smith

SUPPLIERS OF EQUIPMENT FOR MANUFACTURING LUBRICATING GREASES

Barrett Manufacturing Company
P. O. Box 8096, Houston 4, Texas
Representative—George J. Barrett, Jr.

Chemicolloid Laboratories, Inc.
55 Herricks Road, Garden City Park, N. Y.
Representative—David F. O'keefe

The Girdler Company
A Div. of National Cylinder Gas Co. Box 987
Louisville 1, Kentucky
Representative—J. E. Slaughter, Jr.

Manton-Gaulin Mfg. Co., Inc.
44 Garden Street
Everett 49, Massachusetts
Representative—G. W. Eldridge

Morehouse-Cowles, Inc.
1152 San Fernando Rd., Los Angeles, Calif.
Representative—George E. Missbach

HARSHAW LEAD BASE

Harshaw Lead Base, as an additive to petroleum lubricants, improves extreme pressure characteristics and imparts the following desirable properties:

- Increased film strength
- Increased lubricity
- Improved wetting of metal surfaces
- A strong bond between lubricant and metal surfaces
- Resistance to welding of metals at high temperatures
- Moisture resistance and inhibits corrosion

Harshaw Lead Bases are offered in three concentrations to suit your particular needs:

Liquid	Liquid	Solid
30% Pb	33% Pb	36% Pb

Other metallic soaps made to your specifications. Our Technical Staffs are available to help you adapt these products to your specific needs.

THE HARSHAW CHEMICAL CO.
1945 E. 97th Street • Cleveland 6, Ohio
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NLGI Associate, Technical Members

Stratford Engineering Corporation
612 W. 47th Street, Kansas City 12, Missouri
Representative—D. H. Putney

Struthers Wells Corp.
1003 Pennsylvania Ave. West, Warren, Pa.
Representative—K. G. Timm

SUPPLIERS OF MATERIALS FOR MANUFACTURING LUBRICATING GREASES

Acme-Hardesty Company
60 East 42nd St., New York 17, N. Y.
Representative—W. C. Hardesty

American Cyanamid Company
30 Rockefeller Plaza, New York 20, N. Y.
Representative—B. H. Loper

American Potash & Chemical Corp.
99 Park Avenue, New York 16, N. Y.
Representative—W. F. O'Brien

Archer-Daniels-Midland Company
Chemical Products Division
P. O. Box 839, Minneapolis 2, Minn.
Representative—Frank C. Haas

Armour & Co., Chemical Division
1355 West 31st St., Chicago 9, Illinois
Representative—W. L. Riegler

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NEWARK, N. J.

TOLEDO, OHIO

★

Manufacturers of

LUBRICATING GREASES

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Godfrey L. Cabot, Inc.
77 Franklin Street
Boston 10, Mass.
Representative—H. P. Donohue, Jr.

Climax Molybdenum Company
500 Fifth Ave., New York 36, New York
Representative—Elwin E. Smith

Darling & Company
4201 South Ashland Ave., Chicago 9, Illinois
Representative—G. W. Trainor

E. I. du Pont de Nemours & Co.
Wilmington, Delaware
Representative—R. O. Bender

The Elco Lubricant Corporation
Jennings Road & Denison Avenue
Cleveland 9, Ohio
Representative—Frank X. Sieloff

Emery Industries, Inc.
4300 Carew Tower, Cincinnati 2, Ohio
Representative—G. W. Boyd

Enjay Company, Inc.
15 West 51st St., New York 19, New York
Representative—Sidney W. Fay

Foote Mineral Company
18 W. Chelten Ave., Philadelphia 44, Penn.
Representative—W. F. Luckenbach

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Products Development Laboratory
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Representative—Alberic T. DiMasi

NLGI News

Continued from page 47

Preview of SPOKESMAN Articles to Be Published

In coming issues of the NLGI SPOKESMAN the following articles will be presented:

"Shear Stability of Bentone Grease," by H. F. Sutter of Baroid Division, National Lead company. The author presents test results of the mechanical stability of kettle milled bentone greases.

"Development and Application of a Broad Performance Range Gear Lubricant Additive," by R. K. Williams, W. C. Brandow and J. W. Schulte of the Lubrizol corporation. A history and development of extensive laboratory and road tests for different makes of cars and trucks are discussed, to illustrate a large scale program by the company to develop an all purpose additive.

"General Motors Looks at Rear Axle Lubricants—September 1957" by N. A. Hunstad, General Motors corporation, shows a logical progression of the axle lubricant problem based on results of tests and service experience. Hunstad is a past contributor to NLGI SPOKESMAN articles.

Articles presented at the 1957 NLGI annual meeting will appear early in 1958.

R. Cubicciotti Presents Film to API Lubrication Committee

One of the first official duties of NLGI's new president, R. Cubicciotti, was to give a showing of the Institute's movie "Grease, the Magic Film" at the Lubrication Committee meeting of the Marketing Division, during the 37th Annual meeting of the American Petroleum Institute in Chicago last month.

About 150 attended the showing of this picture. The lubrication session was presided over by F. E. Rosenstiehl, chairman of the Lubrication Committee and NLGI's new vice president.

API Lubrication Committee To Hold Marketing Meetings In January and February

Given below is information furnished by the Division of Marketing of the American Petroleum Institute concerning the following meetings of the Lubrication Committee in January and February, 1958:

The meeting of the operating committee will be held January 14 in the Fort Shelby hotel, Detroit, Michigan. The Shelby room is the scheduled location, where the meeting will begin at 10 am.

This meeting is being scheduled in conjunction with the annual meeting of the SAE, and all members of the Lubrication Committee who will be in Detroit for the SAE meeting are invited to attend this meeting of the Operating Committee.

The traditional February meeting of the Lubrication Committee, held annually in Detroit, has been scheduled for Thursday and Friday, February 27 and 28, at the Sheraton-Cadillac hotel.

For this meeting it is planned to follow the scheduling which has been found so successful in the last few years. That is, the general session devoted to a program of interest to both automotive and petroleum people will be held on the first day and the traditional banquet will be held on the first evening, February 27. The business meeting of the Lubrication Committee will be held on the morning of the second day, February 28.

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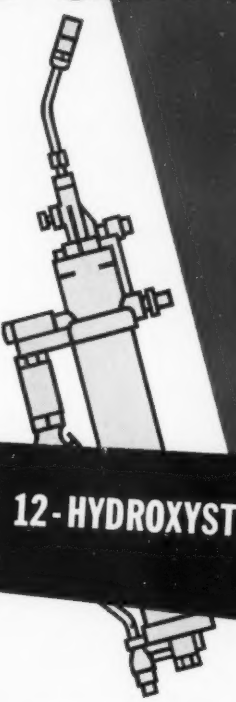

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10 Lithium Base Lubricating Greases
11 Sodium Base Lubricating Greases
12 Lead Soap Lubricating Greases
13 Strontium Base Lubricating Greases
14 Miscellaneous Metal Soaps as Components of Lubricating Greases
15 Mixed Base Lubricating Greases
16 Complex Soap Lubricating Greases
17 Non-Soap Thickeners for Lubricating Fluids
18 Fillers in Lubricating Greases and Solid Lubricants
19 Residua and Petrolatums as Lubricants
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The book begins by describing in detail the structure and theory of lubricating greases. Then follow chapters on the various raw materials, processes and manufacturing equipment. Lubricants containing specific thickeners, including such recent developments as lithium soaps, complex soaps and non-soap gelling agents, receive special attention.

Of major interest is the large section on present uses and future trends of lubricating grease products. Here you'll find the complete details of when, where, and how to apply a specific lubricant for any given purpose.

Everyone concerned with the preparation or use of grease lubricants will find Boner's book of enormous practical value. Manufacturers and lubricating engineers will find here a complete breakdown of the effects of each ingredient or treatment upon the characteristics of the final product, and a full explanation of the physical and chemical methods used in measuring these characteristics. Suppliers of fats, oils, additives, thickeners and other raw materials will gain new ideas for future product research and development. In addition, users of grease products will learn the properties of available lubricants and the major purposes that each fulfills.

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C. W. Nofsinger Company Purchases Office Building

The petroleum and chemical engineers and contractors firm, C. W. Nofsinger company, has recently purchased and moved to new and spacious quarters in Kansas City, Missouri's Country Club district at 307 East 63rd Street. With a considerably expanded personnel staff, the company feels it can now render better service to its clients and provide more congenial surroundings for both clients and personnel.

Formerly located in a downtown office building, the company now owns a southern colonial building of approximately 10,000 square feet of space, with white painted masonry and cedar shake roof shingles, and patios which provide parking space for 35 cars.

C. W. Nofsinger company was organized in 1950 and maintains a sales office in Los Angeles, California.

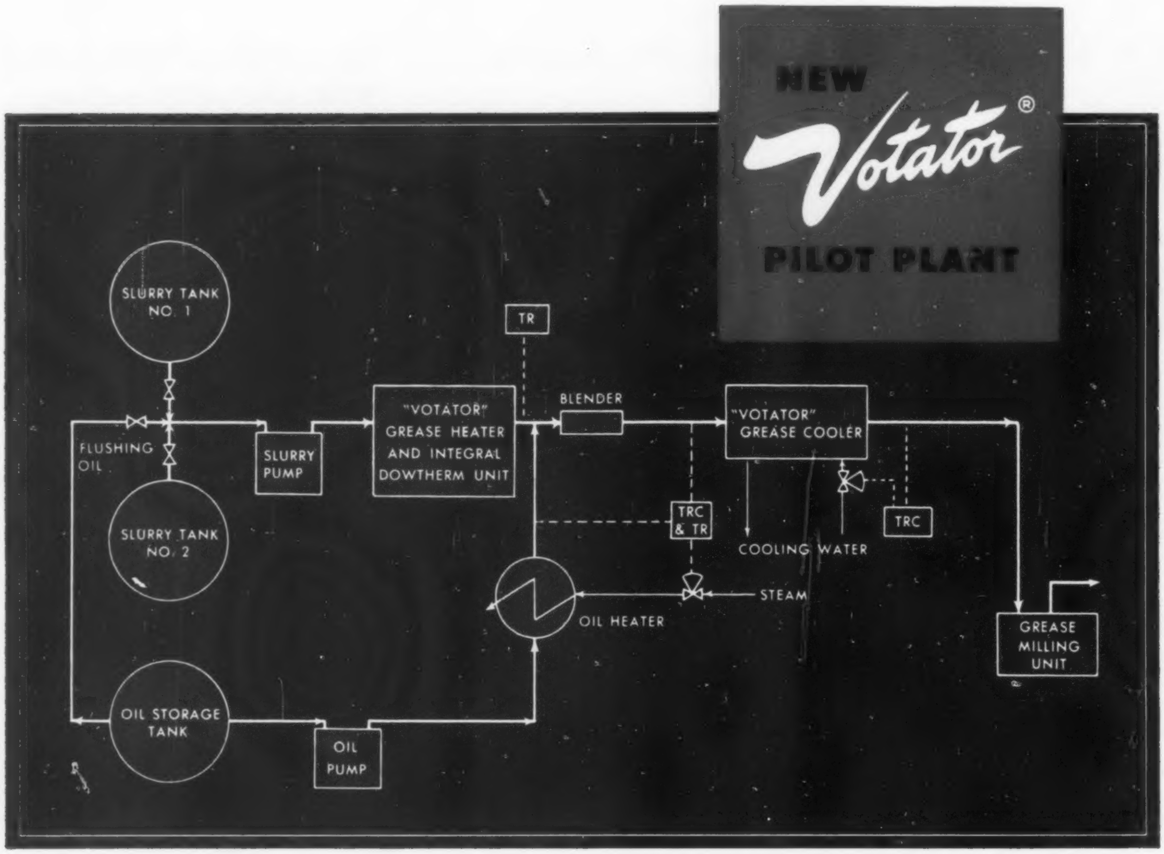
Siloo Introduces All-Purpose White Lubricant in a Tube

A new, all-purpose white lubricant in a tube has just been announced by Siloo corporation, 331 Madison Ave., New York 17, N.Y.

This product, called White Lube, is based on an exclusive Siloo formula that combines the requirements of all single-purpose greases into one multi-purpose lubricant, claims the manufacturer.

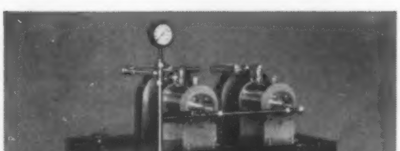
Siloo White Lube works with outstanding effectiveness at all temperatures—from a high of 375 degrees F. to sub-zero. The product has excellent film strength and stands up under all loads and speeds.

According to the manufacturer, White Lube has hundreds of applications—in brake work, wheel bearings, distributor cams and shafts, water pumps, fan belts, and chassis.



NEW *Votator*® PILOT PLANT

simplifies research in lithium grease and specialty lubricants



VOTATOR Grease Blending and Cooling Unit of grease pilot plant.

To help you develop improved methods and formulations, Girdler now makes available a complete, compact pilot plant for processing of lithium greases. This new VOTATOR* Grease Processing Equipment can also be used for small-scale, continuous production of specialty lubricants such as diesters and silicones. Schematic flow chart for the plant is shown above. Its features:

VOTATOR grease heater has integral electrically heated Dowtherm vaporizer.

All process variables such as temperatures and throughput rates can be changed in a few seconds.

Variable capacity pumps allow rapid change of slurry and oil ratios for easy study of various soap concentrations.

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Write today for further information on this new VOTATOR Grease Pilot Plant. The Girdler Company, Votator Division, 224 East Broadway, Louisville 1, Ky.

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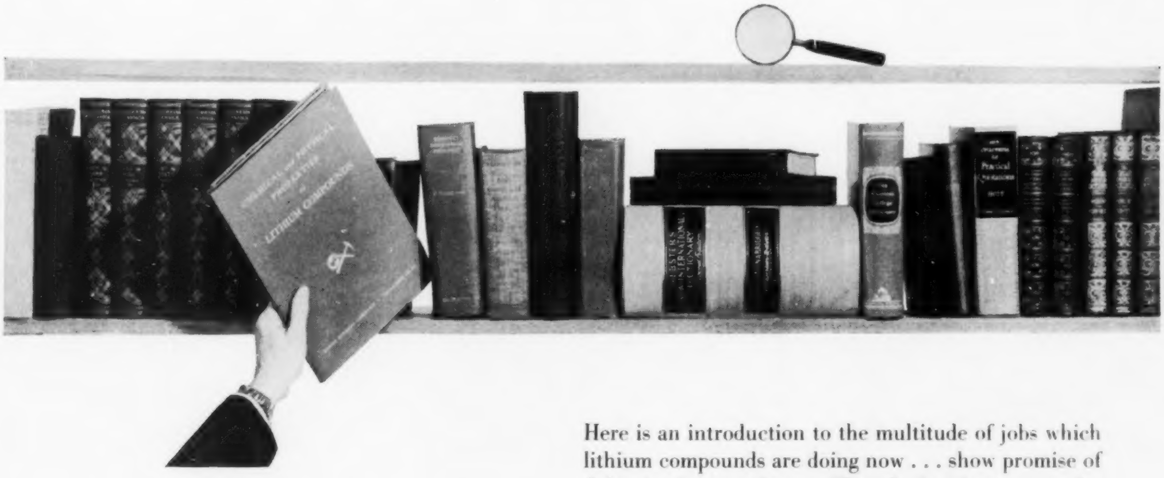

A DICTIONARY OF USES FOR LITHIUM CHEMICALS

past . . . present . . . future

Here is an introduction to the multitude of jobs which lithium compounds are doing now . . . show promise of doing in the near future. Though there's no space for them here, there *are* further details . . . and they *are* available. Let us know which compound or which job you're interested in, and we'll send you whatever data Foote has relating to your field of interest. Write the Technical Literature Department, Foote Mineral Co., 402 Eighteen West Chelten Building, Phila. 44, Penna.

absorbent (CO_2): lithium hydroxide

air conditioning: lithium bromide; lithium chloride; lithium chromate; lithium molybdate

baths (heat treating): lithium fluoride; lithium chromate

battery (alkaline electrolyte): lithium hydroxide monohydrate

catalyst (crystal formation, esterification): lithium carbonate

catalyst (polymerization; reduction): lithium metal

ceramic (enamels, frits, glazes, etc.): lithium carbonate; lithium chloride; lithium fluoride; lithium nitrate

ceramic (raw material) lithium carbonate; lithium fluoride; lithium hydroxide monohydrate; lithium borate

coating (lens): lithium fluoride

coating (welding rod): lithium carbonate

conductivity* (increasing of electrolytes, fused salts): lithium chloride

coolant: lithium chloride; lithium metal

corrosion inhibitor: lithium bichromate dehydrate

cosmetics: lithium stearate

crystals (optical): lithium fluoride

dehumidifier: lithium chloride

de-icer: lithium chloride

dispersing agent: lithium citrate

dispersion stabilizer (deflocculant, ceramic): lithium citrate

electrolyte: lithium hydroxide

explosive:* lithium chlorate; lithium nitrate; lithium perchlorate

fillers* (rubbers, plastics): lithium aluminum silicate

flux (ceramic): lithium fluoride

flux (soldering): lithium borate

flux (welding and brazing): lithium chloride; lithium fluoride

freezing point depressant: lithium chloride

fuel*: lithium hydride; lithium metal

grease: lithium hydroxide monohydrate; lithium stearates

heat (transfer medium): lithium chloride; lithium metal

mud* (oil well drilling conditioner): lithium phosphate

nuclear material*: lithium metal

oxidizing agent*: lithium bichromate dehydrate; lithium chlorate; lithium chromate; lithium perchlorate

pharmaceuticals (production of): lithium carbonate; lithium chlorate; lithium citrate; lithium metal

plating reagent: lithium citrate; lithium cyanide; lithium hydroxide

pyrotechnics*: lithium chlorate; lithium nitrates; lithium perchlorate

reducing agent: lithium hydride; lithium aluminum hydride; lithium borohydride; lithium metal

scavenger (metallurgical): lithium metal

solder (silver): lithium metal

suspension stabilizer: lithium citrate

* You may very well be the *first* to take advantage of this potential use for lithium compounds.

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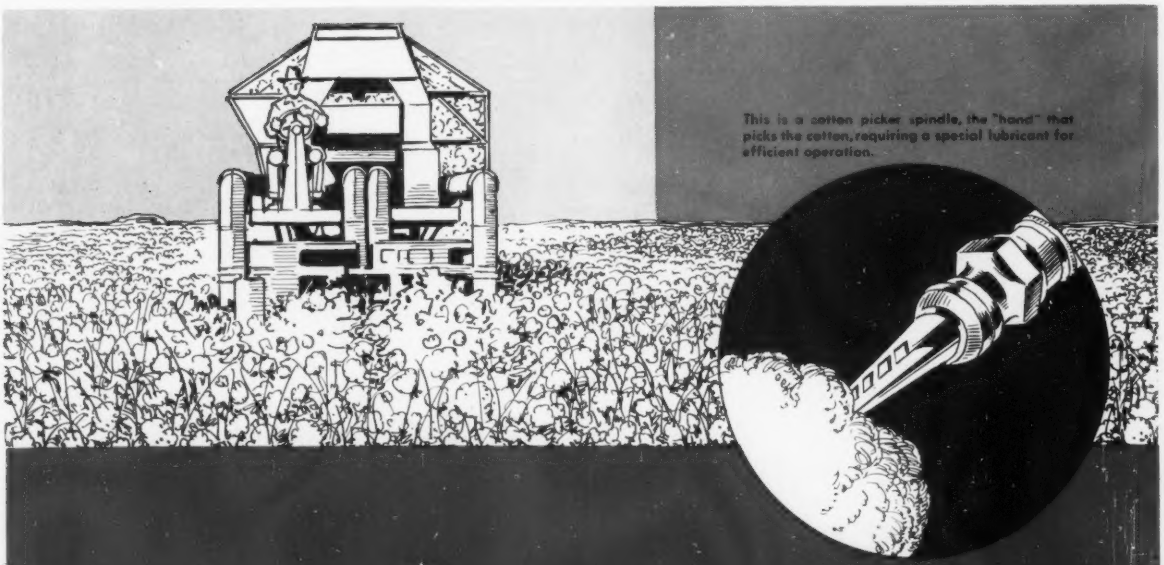

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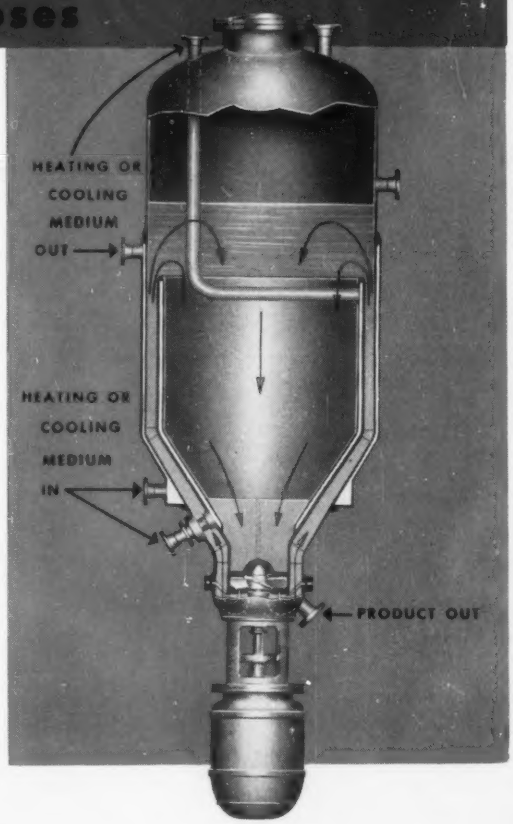

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